SCIENCE

VOL. 87 FRIDAY, JUNE 24, 1938 No. 2269

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington, D. C.

THE CHEMISTRY AND BIOLOGICAL SIGNIFICANCE OF THIAMIN

By Dr. ROBERT R. WILLIAMS

BELL TELEPHONE LABORATORIES, NEW YORK, N. Y.

SOMETHING more than fifty years ago the Japanese Navy annually suffered an incapacitation of from 23 to 40 per cent. of its effectives. The disease which the Japanese called kakke was also prevalent among the civilian population, not only of Japan but of Asia generally. In China it was recognizably described more than 300 years ago. Its devastations among the Malay peoples of the peninsula and of the great islands of the East Indies is attested by the fact that the world at large has adopted the Malay term beriberi for the disorder. It is, however, no stranger in India, Siam and Burma.

It was the Japanese, however, who first afforded convincing evidence regarding its general nature. Takaki, in effect surgeon general of the Japanese Navy, observed in 1883 a disastrous outbreak during a six months' voyage of the training ship, *Riujo,* and being convinced of the nutritional nature of the disease ordered an experimental duplication of the cruise with the sole alteration of a change of ration. The comparative results of the two cruises were so striking that the changes in ration were presently made effective for the entire Navy with the result that the incidence of beriberi has never, since 1885, risen to as high a figure as one half per cent. of the force.

Takaki had little notion of the specific nature of the shortage in the diet. The beginnings of this disclosure were left for Eijkmann, medical officer in the Dutch colony in Java. In the course of experiments aimed at a study of the disease, he encountered its counterpart in chickens which for the sake of economy had been fed on waste rice from the hospital kitchens. He published his results in 1897. There followed many further studies from his laboratories, studies to which neither the world at large nor even the medical profession of the Orient paid prompt attention. A few discerning persons took them seriously. These were mostly Englishman in overseas service, Braddon,

Fletcher and Fraser and Stanton. It was not till Funk in 1911, first working at Pasteur and later at Lister Institute, claimed the isolation of a specific substance to which he gave the name vitamine that the world at large took a hand in the study. The nutritional paralysis in pigeons with which Funk principally worked is perhaps even more striking than in chickens. A novice can readily reproduce the results and recognize the condition. All one has to do is to coop up the birds and feed them for a month on polished rice or white bread. In the throes of the disease the birds' movements are wholly incoordinated and consist in turning cart wheels or aimless floppings as if freshly decapitated.

While largely ignorant of beriberi, the rest of the world was becoming conscious in this interval of the necessity in foodstuffs of essential accessory substances. Many students contributed, but the names of Stepp, of Hopkins, of Osborne and Mendel and of McCollum are prominent. They worked largely witdh rats, noting the stunting of growth which ensues from a want of these substances. It was natural at first to suppose that all these phenomena were variable expressions of a single deficiency. Few had courage to believe that after all the extensive study of metabolism which had been carried on there should still remain a large number of unidentified essentials. It is indeed true that the beriberi preventing substance is a growth promoter of great importance for young rats, so much so that on certain diets at least the extent of growth depends on the amount of the substance in the food and generous supplies may lead to somewhat supernormal growth. The fact that this vitamin appears to play a role particularly with reference to nerve function has been allowed to obscure somewhat its broader role with reference to tissues in general. That its role is a general one is indicated by the wide-spread pathological changes which result from a deficiency of it, by its effects upon appetite, food consumption and skeleton size, and its therapeutic value in a somewhat diverse set of conditions.

Those who do not know beriberi will be curious as to how its affects human beings. For reasons which we do not know it takes two distinct forms, the wet and the dry. The contrast in appearance is conspicuous because of the accumulation of water in the tissues in the former case, while in the latter atrophy of the musculature becomes prominent. In most essential respects the two forms are alike. In both, there is numbness of the extremities amounting to anesthesia yet exquisite tenderness of the muscles to pressure. In both, the patellar and other reflexes are either exaggerated or lost altogether. In both, the heart is affected by an accumulation of fluid in the pericardium. Fluid is also usually present in the lungs. The right heart is most affected. Death, which often comes suddenly after some exertion, is due to heart failure. Response to treatment is often dramatic in the acute fulminating type of the disease, though complete recovery from the secondary effects of the disease, if it has existed for a long time, is usually discouragingly slow.

As we now know, the beriberi vitamin is only one of several substances which are of crucial importance in connection with various deficiency diseases. It was due to the presence in yeast, rice polish, etc., of these numerous substances of physiological importance that so much confusion arose about the B vitamins. This long delayed a satisfactory isolation of the substance in a pure state. For, if one has to depend on a biological test as a guide in the chemical procedures, he can be grossly misled if he does not choose the right test. There are several B vitamins, each of which contributes to the growth of rats so that the growth test in its cruder forms led us up many a blind alley. Tests which depend solely on the cure or prevention of polyneuritis have proved much more serviceable for our purposes. Happily, however, our mistakes and disappointments have helped to forward the progress of other workers toward other important goals concerned with dietary deficiencies.

It was not till nearly thirty years after Eijkmann described avian beriberi that others, working in the same laboratory in Java, succeeded in obtaining the substance in pure form. To Jansen and Donath must go the honor of first isolating the pure substance. This was a fitting culmination of a long series of important contributions from the Dutch. For six years no one was able to repeat their work elsewhere, but their descriptions of the substance are unmistakable. Yields of it were so small that chemical study was greatly handicapped for lack of material.

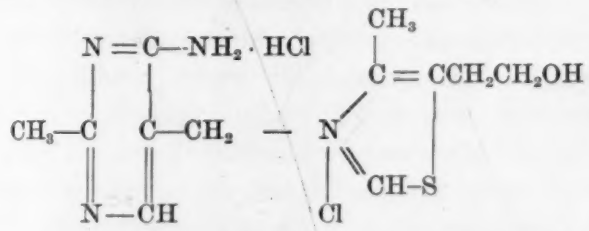
This was to a great extent remedied by improvements in process which were put into effect in America. The nature of the undertaking with which we were confronted is well illustrated by the range of scale on which we were compelled to work. In the initial step we used a 1,300 gallon tank for extracting the rice polish; in the final step, a test-tube. The product was dissolved in 0.5 cc of water and caused to recrystallize by adding 10 cc of absolute alcohol. There are only 40 to 50 parts per million of the vitamin in the original rice polish, of which about one fourth could be recovered as crystalline material.

The object of all this work was not primarily to obtain a concentrated form of the vitamin with which to treat human beriberi. Relatively crude products would serve that purpose at least moderately well. The object was rather to learn the architecture of the molecule in order to ascertain what it does in the body and how it works. At first we had little thought of a

practical artificial synthesis, as no one could foretell whether such a synthesis would be feasible even if we once learned the structure.

The method which the organic chemist follows in determining the structure of an unknown molecule is to tear it by progressive steps into fragments. When the fragments become small enough the chemist can recognize them by comparing them with simple substances whose architecture is already known. Having recognized the ultimate fragments, he must fit them together bit by bit to form the primary fragments and if possible the original molecule. It is like the familiar jigsaw puzzle, except that one can never see the picture, let alone the pieces, except in the mind's eye. It is all a rather abstruse business which takes on the air of reality even for the chemist himself only when he has in his hands the substance itself and finds that, though it has been constructed to a pattern existing in his imagination only, it possesses the properties of nature's own product. In this case it cures beriberi.

In presenting to you the study of the structure of the molecule, it will only be possible to give you some notion of the procedure. Like standing an egg on end it will seem easier if we first give the result and then tell you how it was obtained. The structure now universally accepted is as follows:



Its most conspicuous features are its two nuclei. By treating the vitamin with sulfite we were able to obtain one of these as a sulfonic acid, the other as a weak free base. By reducing the sulfonic acid with sodium in liquid ammonia, we were able to obtain a 2,5-dimethyl-6-amino pyrimidine which we eventually duplicated by synthesis after trying one after another the various compounds of the same composition in which the methyl groups are in other positions. We also were able to reproduce synthetically the oxy-sulfonic acid which we derived from the vitamin by hydrolysis of the primary product of sulfite cleavage.

As for the other product of sulfite cleavage, the weak base yielded on oxidation with nitric acid 4-methyl thiazole-5-carboxy acid, prepared synthetically by Wohmann nearly fifty years ago. Wohmann had never heard of vitamins and of course had no idea how or whether his information would ultimately be used. But he set it forth in publication and at long last it fulfilled its destiny. So shall it always be with hundreds and thousands of the humbler records of science if only they are correct. In this instance an erroneous analysis or melting point by Wohmann might have led us far astray, perhaps for years.

While the isolation of the vitamin required more than twenty years of intensive work in many countries, the development of its structure was fully accomplished in less than three years. Once the structure was known with certainty its synthesis followed in a few months. The synthesis of the thiazole portion came first by the condensation of thioformamide with bromacetopropyl alcohol. That of the pyrimidine is more roundabout and difficult but follows along lines which had already become familiar in the course of producing the various pyrimidines needed for comparison purposes during the establishment of structure. Finally the two portions were fitted together and the properties of the natural product were duplicated. Already hundreds of kilos of the compound have been produced commercially and it is finding an extensive use in medicine even in well-fed America.

This would have been a matter of great surprise to us who worked in the Philippines twenty-five years ago with what we called the "beriberi preventing substance." We then supposed that a deficiency of it could develop only when human dietaries are very restricted. We even supposed that its occurrence in foods was a matter of chance. We also supposed that this vitamin had peculiarly to do with the nutrition or function of nerves. Hence arose the name antineuritic vitamin and later "aneurin" was proposed by Professor Jansen, who was instrumental in first isolating it. Both these views have proven far too narrow as we shall see. In view of its extensive use in medicine, it has seemed necessary and proper to conform to the views of the American Medical Association regarding a name based upon chemical facts rather than conceptions of therapeutic value. Upon invitation, I suggested the name thiamin to imply that it is the sulfur-containing vitamin. This name has been tentatively adopted by the American Society of Biological Chemists and the American Institute of Nutrition and has been recommended to the International Conference for consideration.

During the period when the neuritic character of beriberi was still very prominent in all minds, studies were begun at Oxford upon the nature of the biochemical defect in the nervous tissue. Peters found first an excess of lactic and later of pyruvic acid in the brains of polyneuritic pigeons. The excess was not equal in all parts of the brain but was greater in the lower part and in the optic lobes. When the brain tissue of freshly killed polyneuritic pigeons was placed in Ringer phosphate solution in the presence of glucose, lactic acid or pyruvic acid, it was found to be subnormal with respect to its capacity to take up oxygen from the air. This deficiency in oxygen up-

take was greatest in the brains of birds which were fully polyneuritic. Birds fed on polished rice for lesser periods of time yielded brain tissue of less subnormal respiratory capacity. Moreover, the deficiency of oxygen uptake was localized in the same parts of the brain as showed the greatest excess of pyruvic acid. When birds were treated with preparations of the vitamin and thus cured of their acute symptoms, the respiration of their brain tissue was found high enough to justify the assumption that it had partially regained its lost function. Still more striking was the later finding that it is not necessary to give the thiamin to the living birds. It may be added to the medium in which the polyneuritic brain slices are respiring and there produces the same effect of increasing the oxygen uptake and promoting the metabolism of the lactic or pyruvic acid.

Now all this is extremely important, not only because it tells us that something is chemically wrong in the brain but also that it is the carbohydrate metabolism which is impaired. This is derived from the fact that lactic and pyruvic acid are normal intermediates in the metabolism of carbohydrates by all cells. When yeast ferments sugar, it converts the six carbon chain of the sugar into two moles of the 3 carbon atom pyruvic acid by splitting the chain in two in the middle. Likewise muscular action in animals uses up sugar and produces lactic acid in its own cells. Fatigue of the muscle is intimately related to the accumulation of lactic acid in it. What is true of yeast and muscle is also true of many other cells which have been studied: *viz.*, that their living processes involve the conversion of glucose into vital energy via pyruvic acid.

As a beautiful confirmation of Peters' ideas about the biochemical defect in polyneuritis, there was isolated only a year ago by Lohmann and Schuster a substance which turns out to be the pyrophosphate of thiamin. It is present in yeast in amounts sufficient to account for all the thiamin which the cells contain. It has the properties of the cocarboxylase postulated by Auhagen in 1932. Without it yeast can not ferment sugar. Yet thiamin pyrophosphate itself can not ferment sugar unless it is accompanied by a specific protein which may be extracted from yeast and which, unlike thiamin pyrophosphate, is rendered inactive by a few minutes heating. The two together constitute an enzyme capable of converting pyruvic acid to acetaldehyde and carbon dioxide. It has antineuritic properties like those of thiamin itself and is capable of promoting the oxygen uptake of polyneuritic tissue.

Now free thiamin can not function as the coenzyme for the carboxylase of yeast. The pyrophosphoric acid is essential to this function. This is the second instance of a phosphorylated vitamin in the B group, for riboflavin phosphate has been shown to be the coenzyme of a yellow respiratory pigment which functions as a dehydrogenase. Since it is also true that nicotinic amide, which now appears to be the essential pellagra vitamin, is a part of the prosthetic group of cozymase and of a ferment of red blood cells, one is strongly tempted to believe that the water-soluble vitamins as a class are essential components of the enzyme systems by which living matter carries on metabolism.

As far as thiamin is concerned it seems clear that it enters into several enzyme systems. With polyneuritic brain tissue, increased oxygen uptake is the most conspicuous feature, the pyruvic acid consumed being sufficient to account for the oxygen only on the basis of its nearly complete conversion to CO_2 and water; in yeast, as we have seen, there is in effect no oxidation, merely a pure decarboxylation. Between these two extremes are the lactic acid bacteria of Lipmann, where there is oxidation *and* decarboxylation and the behavior of staphylococcus which, according to Krebs and Hills, results in a dismutation—*i.e.*, simultaneous oxidation and reduction with decarboxylation also entering in. Krebs' recent finding of citric and α keto glutaric acids in the urine of thiamin deficient rats conforms to Krebs' theories regarding the normal course of carbohydrate metabolism. Perhaps it will turn out that some positive knowledge of what happens to a sugar molecule in the body will be one of the principal fruits of the whole thiamin research.

Thiamin is present in so many hundreds of living tissues, animal, vegetable and microorganic, and has been demonstrated to play an indispensable role in such a considerable number of them, that the burden of proof now lies upon him who would dispute the *universality of its function* in living things. Yet it is present in tissues in very small amounts, usually less than one part per million. In seeds and in certain special animal organs, such as the liver, it may rise to three to five parts per million; only in the germs of cereals and in the cells of cereal-grown yeasts does it rise to thirty to one hundred parts per million. The lower saprophytic plants lack the power to synthesize it adequately and always respond with evidences of more vigorous vital function when given a liberal supply from some external source. Animals are unable to synthesize it from the elements at all. Only the higher plants can make it. Evidently they make it in the tops, probably in the leaves, transporting it thence to the roots which are unable to produce it.

Many interesting experiments regarding its function with respect to root growth have been performed by Kögl, by Bonner and by Robbins. It is to the latter that we owe some entrancingly interesting pictures which illustrate the fact that the growth of excised tomato roots in sugar solution depends quan-

titatively on the amount of thiamin added. In some of the experiments the fact is brought out that a mixture of the intermediates from which thiamin is made artificially will serve as well as thiamin itself for many plants. This indicates that the power to effect the final step of synthesis is often present in organisms or parts of organisms which have never acquired or have lost the power to effect the entire synthesis. It also suggests strongly that nature's method of synthesis is identical as to the last step with that whereby we made the vitamin in the laboratory. Some plants show a more conspicuous need of the thiazole part, some of the pyrimidine part, presumably because they differ with respect to their synthetic capacities for each part. Some plants, like all animals, must have the fully formed vitamin and can not effect even the final step of synthesis.

What does it mean with respect to the realm of nature as a whole? Its presence in seeds in large amounts seems to me highly significant, especially in view of the fact that seeds are often also repositories of carbohydrate dedicated to the nourishment of the seedling during the process of germination until the young leaves turn their green surfaces to the sun. More and more it seems that man commits a crime against nature when he eats the starch from the seed and throws away the mechanism necessary for the metabolism of that starch by the plant. Since plants have synthetic powers which men lack, the latter have small prospect of successful utilization of the starch unaided by the plants' enzymic component.

In fact as one surveys the situation in philosophical mood it seems that nature's entire economy of thiamin is hand to mouth. Her synthetic powers are barely adequate to keep life as a whole moving forward. She has to resort to symbiosis, whereby the synthetic deficiencies of one organism are made good by the scant surplus of others. She utilizes the dead remains of some of her children that others may grow and propagate their kind. She transports the substance from favored parts to those which are deficient in their synthetic powers. Very widely is it true that a generous external supply of thiamin increases visibly the vigor of the life processes of plants and animals. Probably the chemical instability of thiamin contributes materially to the economy of want.

It would be misleading to suppose that thiamin is the only vitamin which possesses a universal or nearly universal function in living cells. Vitamin C, vitamin B_2 and nicotinamide all appear to play somewhat similar roles. Thiamin is merely the most conspicuous example. The lack of no other accessory substance leads to so early, so profound and so universal a disaster.

These considerations also serve to explain the hitherto baffling problem of thiamin economy in human beings. It is a striking fact that the physiological consequences of thiamin deficiency affect every tissue. Pathological changes in beriberi affect nearly all internal organs. Also in practical trials of thiamin in therapy, favorable responses have been reported in a wide diversity of disordered conditions. In vain have we endeavored to find *the* specific effect of a deficiency of the substance and yet it is credited with almost panacean properties.

The reason is, we believe, that carbohydrate metabolism can not go forward in any living cell without thiamin. One of the outstanding achievements of modern biochemistry is the production of evidence that all cells, no matter whether of tiny unicellular organism or those of highly specialized tissues, have common needs. The liver, pancreas, the brain and each other organ of higher animals performs a special function for the entire assembly of cells which make up the body. But just as each home in a human society subsists by exchange of goods and services with others yet maintains its own kitchen and its own hearth so every cell carries on metabolism and generates energy within itself.

Mankind often lacks an ample supply of thiamin because nature generally must ration it carefully and further because he refines his grains and cooks his food. So when he suffers from constitutional disease his weakest organ may often show a benefit from an artificial supply whether the weakness be due to heredity, to past damage or to present severe strain upon the body economy, as in maternity, hard physical labor or in infectious fever. The apparent want is probably rendered more wide-spread by the fact that in human society the physically unfit increasingly survive and propagate their kind through interruption of the process of natural selection by humanitarian effort.

THE FUTURE OF THE CRELLIN LABORATORY[1]

By Dr. LINUS PAULING

DIRECTOR OF THE GATES AND CRELLIN LABORATORIES OF THE CALIFORNIA INSTITUTE OF TECHNOLOGY

ABOUT twenty years ago, to house the division of chemistry and chemical engineering, which was beginning its rapid expansion under the direction of Professor Arthur A. Noyes, there was constructed the Gates Chemical Laboratory, the gift of Mr. Charles W. Gates and his brother, Mr. Peter G. Gates. This

[1] Address at the dedication of the Crellin Laboratory of Chemistry at the California Institute of Technology, May 16, 1938.

marked the beginning of the period of development of the California Institute of Technology as an advanced scientific school. The second unit of the Gates Laboratory was built ten years later. In view of the personal interests of Professor Noyes, who was the leader in the introduction of the new methods of physico-chemical research in America forty years ago and the founder of the Research Laboratory of Physical Chemistry at the Massachusetts Institute of Technology, it is not surprising that the men whom he gathered about him were primarily interested in the field of physical chemistry and that it was in this field that their principal contributions to knowledge were made.

Professor Noyes, however, recognized the great importance of organic chemistry, and especially of that branch of organic chemistry dealing with substances which are physiologically active, such as vitamins and hormones; and he made plans for the development of the work of the division in this new direction. In my file of letters from Professor Noyes there is one, written in 1929, which contains a detailed chart of the course on which the division is now embarking, nine years later.

It was the interest taken in the work in chemistry at the institute by Mr. and Mrs. E. W. Crellin, leading to the construction of the Crellin Laboratory, which made the initiation of this new program possible. The Rockefeller Foundation, recognizing the need for fostering research in America in the border-line field between chemistry and biology and the suitability of the California Institute for this work, then made a large grant of money to support the researches to be carried on in the Crellin Laboratory during the next six years.

Organic chemistry was developed into a great science during the nineteenth century, and it seems probable that all or nearly all its fundamental principles have now been formulated. There is, however, a related field of knowledge of transcendent significance to mankind which has barely begun its development. This field deals with the correlation between chemical structure and physiological activity of those substances, manufactured in the body or ingested in foodstuffs, which are essential for orderly growth and the maintenance of life, as well as of the many substances which are useful in the treatment of disease. These various physiologically active substances are often extremely complex. Their chemical investigation has been made possible only by the development in recent years of highly refined techniques, permitting the organic chemist to determine the molecular structure of a very complex substance, even though it may be available only in minute amounts. In his attack on a recalcitrant molecule he may find it necessary to strengthen his forces by calling on the physical chemist, who during the past quarter century has developed powerful methods of studying the structure of molecules.

There are many ways in which chemistry is contributing to physiology and medicine—by the development of new general anesthetics, such as ethylene, vinyl ether and cyclopropane, of local anesthetics and of pharmaceuticals of all kinds, including such substances as sulfanilamide, with its extraordinary efficacy in the treatment of streptococcal infections—and continued progress will be made in these fields in the coming years. Considering the great advances in the study of vitamins and hormones since the time a decade ago when the synthesis of not one vitamin had been achieved, we may predict that success will soon reward the men who are now carrying on the attack on vitamin E and that many important discoveries will be made.

These substances are complex—containing twenty, thirty or forty atoms in the molecule—but not so complex as to make the determination of their structure by existent methods impossible. There is, however, a class of substances of the most extreme importance of life, the proteins, whose molecules contain thousands or tens of thousands of atoms. The proteins occur everywhere and serve the most varied purposes. The class includes such varied substances as pepsin, hemoglobin, albumen, globulin, keratin and insulin. The organic chemist has not succeeded in determining the configuration of any protein molecule, and it is doubtful that his methods alone can be applied with success, because the forces which hold the molecule in its characteristic configuration are probably not the primary valence forces with which he is accustomed to deal. Although there has as yet been little indication of a method of attack which might be successful, I feel that the important steps in the solution of this great problem will be taken during the next ten years, through the cooperation of the organic chemist and his colleagues in associated sciences.

In the Crellin Laboratory the organic chemists occupy the second and third floors and the auxiliary rooms on the roof. Conveniently close, occupying the first floor, basement and sub-basement, are the physical chemists, with their appliances for the study of molecular structure by the methods of photochemistry, magnetochemistry, spectroscopy and x-ray and electron diffraction.

For twenty-five years Professor Howard J. Lucas alone has ably carried the burden of instruction in organic chemistry at the institute, and he and, more recently, Dr. J. B. Koepfli have worked effectively on a research program. During the present year there has been increased activity in this field. There was given in March and April a series of lectures on the chemistry of vitamins by Dr. Alexander R. Todd, of the Lister Institute for Medical Research in London,

who came here as visiting lecturer, and throughout the year chemical studies on vitamins and hormones were carried on in association with Professor F. W. Went and his colleagues in the division of biology. Dr. Edwin R. Buchman, who was associated with R. R. Williams in the structural investigation and synthesis of vitamin B_1 and who has been carrying on his studies of analogues of this substance at the institute, has been given appointment as research associate in organic chemistry; and Dr. Carl Niemann, of the University of Wisconsin and the Rockefeller Institute for Medical Research, has been appointed assistant professor of organic chemistry. Dr. Niemann, whose investigations have dealt with the chemistry of proteins and carbohydrates, is at present studying at the University of London and will take up residence at the Institute in July.

For the satisfactory completion of the Crellin Laboratory credit is due to the architects, Mayers, Murray and Phillip, and their representative Mr. Wayne Soverns, to Professor Robert A. Millikan, Professor W. B. Munro, chairman of the building committee, and Professor R. R. Martel, of that committee, to Professors W. N. Lacey and A. O. Beckman, who represented the division during the preparation of the plans and the construction of the building, to Mr. William C. Crowell, the contractor, and his able assistants, to Mr. Wesley Hertenstein, supervising engineer, and Mr. L. G. Fenner, superintendent of electrical construction, and to many others who contributed to the work. To all these men, and especially to Mr. and Mrs. Crellin, I express the thanks of the division of chemistry and chemical engineering, and its promise to make effective use of the new laboratory.

THE DEVELOPMENT OF CHEMISTRY AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY[1]

By Dr. ROBERT A. MILLIKAN

CHAIRMAN OF THE EXECUTIVE COUNCIL OF THE CALIFORNIA INSTITUTE OF TECHNOLOGY

IN the spring of 1916 all of us scientific ground squirrels, who all over the United States come up occasionally to sun ourselves at the tops of the holes in which we are burrowing, found the news spreading from hole to hole that a new laboratory of physical chemistry was being started at Pasadena, and that this laboratory was to be under the direction of Arthur A. Noyes, who henceforth expected to oscillate between Boston and Pasadena.

The prestige of Dr. Noyes's name was what gave this news particular interest and currency, for the Institute of Physical Chemistry which Dr. Noyes had founded and directed at the Massachusetts Institute of Technology had already become, through his own work and that of the group of brilliant young men who had come out of it, the most outstanding laboratory of its kind in the country. Indeed, Dr. Noyes himself was already regarded as the most influential of the founders and inspirers of physical chemistry in the United States.

Within a few months of this time Dr. Noyes, whom I had never met before, and his old-time M. I. T. friend, Dr. Hale, whom I had known well since 1896, came to my door in the Ryerson Laboratory of Physics at the University of Chicago saying they wanted to talk over plans and discuss possible personnel for the new "Gates Chemical Laboratory." I first saw this laboratory in January, 1917, when I stopped here for a week to give a few lectures in Throop Hall on my way back to Chicago from Berkeley, where I had been giving the so-called Hitchcock lectures. Let me describe what I saw then. Just two buildings on this campus, namely Throop Hall and the Gates Chemical Laboratory, the rest weeds and dead or dying orange trees. Thirty-seven students all told had up to that date, January, 1917, taken the bachelor's degree from this institution, which in 1908 had announced to the world that it proposed to cease to be essentially a manual training high school and become one of the outstanding scientific and engineering schools of the country.

I marvelled then and I marvel now at the intrepidity, as well as the faith and the vision of the men who, led by George Ellery Hale, took the responsibility of making such an announcement. There was not a hundred thousand dollars of endowment in sight when they made it. By 1917 there were a few of them who had stepped up and backed up their words with enough of their own funds to provide some small beginnings of advanced educational facilities. Mr. Arthur H. Fleming and his daughter, Marjorie, had bought the present campus, and with the aid of other public-spirited citizens had provided for the cost of Throop Hall, erected in 1910.

The first provision for advanced work in chemistry or any other science was made six years later in 1916, when the brothers Charles and Peter Gates came forward and built the first wing of the Gates Chemical

[1] Address at the dedication of the Crellin Laboratory of Chemistry at the California Institute of Technology, May 16, 1938.

Laboratory and Majorie Fleming provided a fund for research in chemistry. All honor to these pioneers, who ventured before there was any assurance of success. Ninety-five per cent. of all business ventures fail, and I suspect the record of philanthropic enterprises is not much better. The *"enterprisers"*—the men who start things off *and make them go*—richly deserve all the credits and all the social rewards which they ever get. Thus chemistry, through the Gates brothers, made its start at the California Institute of Technology.

The next chapter reveals the stuff of which Dr. Noyes was made. Though chemistry was his one devotion, and though the building of the Gates Chemical Laboratory gave both it and him the unquestioned leadership in the development of the scientific position of the institute, yet from 1917 to 1921 (he gave up entirely his M. I. T. connection in 1920) he threw himself whole-heartedly, along with Dr. Hale and Mr. Fleming and Dr. Scherer and Dr. Bridge and Henry M. Robinson and Robert Gillis, into the effort to get a better housed and better financed and better manned department of physics at the institute than could be immediately hoped for in the case of chemistry. This definite subordination of his own individual interests and devotions to what he regarded as the larger interests of the enterprise as a whole reveals the unusual objectiveness and greatness of soul of Arthur A. Noyes. Such men are rare, and when one appears the whole world does him homage.

The next big step in the development of chemistry at the institute began to be taken in 1925 when the Gates brothers came forward with the offer to build the second unit of the Gates Chemical Laboratory. This was completed in 1927, and expanded notably the facilities for carrying on the growing work in general, physical, inorganic and industrial chemistry, but organic and structural chemistry, the most alluring and the most promising of the newer aspects of chemical science, were still very inadequately provided for.

Mr. and Mrs. Charles W. Gates then brought the attention of their friends Mr. and Mrs. E. W. Crellin to the opportunities which they themselves had so fully grasped in the earlier chemical developments at the institute. The result seven years later is this beautiful and adequate Crellin Laboratory which we are dedicating to-day, while the maintenance needs of this new work are taken care of through generous grants from the Rockefeller Foundation, which has watched so carefully this young and vigorously growing institution, and has offered to help it substantially at a number of critical junctures. Indeed, its total contributions to the development of the institute, without including its support of the 200-inch telescope project, have now amounted all told to about four million dollars.

Thus the facilities for a frontal attack on the most pressing problems of bio-organic and structural chemistry—that is on the problems of life itself—are now provided through the joint interest and generosity of Mr. and Mrs. E. W. Crellin and the Rockefeller Foundation. With oarsmen like these and those found in the group of institute chemists "pulling at the bars," the chemical bark of the California Institute of Technology can scarcely fail to win in the race for human betterment through chemical and biochemical advances.

OBITUARY

JOHN JACOB ABEL

IN Baltimore, on May 26, 1938, the long career of a great pioneer figure in American experimental medicine ended. Besides being distinguished for his many notable contributions in his chosen fields, John J. Abel will be remembered as the "Father of American Pharmacology" and the founder of a school of pharmacologists. Those with whom he came into intimate contact will never forget his magnetic yet simple personality, his unquenchable devotion to research, his high idealism, indomitable enthusiasm and optimism, his remarkable capacity for turning apparent defeat into victory and the unique ability he had developed for dealing with minute amounts of complex chemical substances of biological importance.

Abel was born on May 19, 1857, near Cleveland. His family came from the Rhine Valley of the Palatinate. He had no scientific forbears on either side. He received his Ph.B. degree from the University of Michigan in 1883, but had an interim of three years in his college course, during which he served as principal of a high school at LaPorte, Indiana, 1879–1880, where he taught Latin, mathematics, physics and chemistry. From 1880 to 1882 he was superintendent of the public schools at LaPorte. Abel must have looked back on these years with satisfaction, for it was in LaPorte that he met a teacher in his school, whom he once described as a "very sweet mild little lady with a great deal of force." This lady, Mary Hinman, became his wife on July 10, 1883, was his companion for fifty-five years, and made possible the life of intense devotion to research which he chose to live. All who knew Abel at all intimately realize the important role which Mrs. Abel played in his successful career.

It was characteristic of the man, that after choosing scientific medicine as a life work, he submitted himself to a prolonged, broad, fundamental training. After a year in graduate study with Newell Martin at the

Hopkins, seven years were spent in some of the leading universities of Europe studying chemistry and medicine. His teachers during this period are remembered for their distinction in their various fields: in anatomy, His, Braume and Schwalbe; in physiology, Carl Ludwig; in pharmacology, Oswald Schmiedeberg; in biochemistry, Drechsel, Hoppe-Seyler and von Nencki; in chemistry, Wislicenus; in pathology, Arnold and v. Recklinghausen; and in clinical branches such men as Wagner, Kussmaul, Erb and Naunyn. His breadth of training is also evidenced by the many universities in which he studied: Leipzig, Strassburg, Heidelberg, Berne, Vienna, Würzburg, Berlin and Paris. In 1888, he received the M.D. degree from the University of Strassburg. Knowing that he had to earn his living and realizing the lack of full-time opportunities in scientific medicine in this country half a century ago, Abel now spent a year "walking the wards" in Vienna to prepare for the possibility of having to practice medicine as the only outlet of a scientific career. It must have been a great relief when he was asked to occupy the chair of materia medica and therapeutics in the University of Michigan, where he remained for two years. In 1893, he came to The Johns Hopkins Medical School as professor of pharmacology, a chair he occupied until his retirement in July, 1932. On his retirement as emeritus professor, he served as director of the Laboratory of Endocrine Research, a special creation for his work, and here he pursued active research until a few days before his death. It was typical of the man that as soon as he was established in this laboratory, a new problem, having nothing to do with endocrines, captured his attention.

During his first years as professor of pharmacology at the Hopkins, he taught physiological chemistry as well as pharmacology, and for many years thereafter the former subject remained under his direction until his former associate, Walter Jones, was made professor of physiological chemistry in 1908.

Abel's contributions to medical science cover a wide range of subjects and extend over a period of a half century. Space will not permit nor is this the place for any detailed analysis or evaluation of his work. The main theme which seems to have attracted his attention early and to which he returned again and again was the isolation of the active constituents of various endocrine glands. That he early appreciated the great significance of such contributions is best shown by a quotation from one of his addresses. "The actual findings of definite and specific chemical principles in the organs of internal secretion has in each case an importance in the way of explaining and correlating a large number of disconnected facts, only to be likened to the discovery of the etiological cause of an infectious disease." His interest in the internal secretions was intense and he was fond of emphasizing the importance of the active pharmacological substances present in our bodies in the aphorism: "We are walking drug stores."

In 1895, nothing was known about the chemical nature of any of the active principles of the glands of internal secretion. Abel started work on the extremely difficult problem of the isolation of the pressor constituent of the suprarenal medulla. The result of this work was the isolation of the hormone, not in the form of its free base but in that of a monobenzoyl derivative. As a result of this pioneer work of Abel, others later obtained the pure crystalline hormone, and this has been followed by thousands of papers by other investigators dealing with the various chemical, physiological and therapeutic aspects of epinephrine. Some years later, when examining a specimen of a tropical toad, which exudes from its skin glands a creamy secretion used as an arrow poison, Abel noticed that this secretion made on a scalpel a peculiar greenish blue discoloration. Remembering that he had seen this color years before on a scalpel used in cutting the medulla of the suprarenal gland, he set to work and soon isolated from this external secretion the now familiar epinephrine.

This pioneer work of Abel in the isolation of epinephrine, the first hormone to have its chemical nature elucidated, his brilliant success in the isolation of the pancreatic hormone, insulin, as a beautifully crystalline compound from inert constituents of pancreatic extracts, and his ingenious invention of the method of dialyzing the circulating blood of a living animal are achievements sufficient to class him as an investigator of first rank. Many other researches were conducted along these lines of the chemical nature of the principles of internal secretion, many of which he never considered worthy of record. His very few general addresses—the Mellon, Harvey, Kober and Willard Gibbs lectures—all deal with the internal secretions and emphasize the importance of chemistry in medical research; they are all examples of painstaking and prolonged preparation in presenting the subject in an erudite and scholarly manner.

In between the periods when intensive effort was directed to problems of isolation of pure crystalline active principles, we find researches of a totally different type—a rather unusual combination for a single individual. The behavior of frog's muscle to acids, pharmacological study of the phthaleins, the efficacy of new antimony compounds in experimental trypanosomiasis, convulsions in frogs produced by acid fuchsin, the influence of the lymph hearts upon the action of drugs in cardiectomized frogs, and the studies on tetanus of the last years are the main examples of this side of Abel's scientific activity. When a new field

was started older interests were for the time cast aside, and all effort was devoted to mastering the new subject. It is, to say the least, extremely rare to find an investigator on his retirement at the age of seventy-five embark on the exploration of a field requiring totally different technique and methods from those with which he had been concerned for nearly half a century. Abel, however, did just this, and it is entirely in keeping with his fearless spirit, indomitable enthusiasm, youthful outlook and receptivity to new ideas, which all of his pupils recognized.

Several of Abel's publications appear under his name alone, but on most of them, especially in later years, we find the names of younger collaborators. Muirhead, Aldrich, Davis, Crawford and Taveau are the only collaborators up to the end of the epinephrine period; Ford, Rowntree, Barbour, Macht, Turner, Pincoffs, Rouiller, Kubota, Nagayama, Geiling, Bell and Wintersteiner were collaborators in the next period until retirement; the names of Evans, Hampil, Lee, Jonas, Firor and Chalian appear on one or another of his tetanus papers. The above list by no means includes all the many pupils or assistants who were in the laboratory at one time or another, many of whom never collaborated with Abel in his researches, but developed fields of interest of their own quite different from those of "the Professor." Important contributions on other topics appeared in an unbroken stream from his laboratory during the forty years of his directorship. Many of his pupils have occupied or now occupy important chairs of pharmacology, and even clinical medicine.

Abel found his greatest enjoyment in actively carrying on research with his own hands and became completely wrapped up in the major problem engaging his interest. In spite of his wide interests, he refused to allow himself to be side-tracked from his major objective of the time, which would appear to explain why he did not figure in the usual accompaniments of a successful scientist—medical societies, committees, boards, etc. In view of this rather limited activity outside of his laboratory and study, it is curious to see his intense interest in scientific journals and in the organization of national scientific societies. He served from 1896–1905 as associate editor of the *Journal of Experimental Medicine* when it was first established. He founded the *Journal of Biological Chemistry* with Herter in 1905 but withdrew from active editorship in 1909 to found *The Journal of Pharmacology and Experimental Therapeutics,* which he edited for twenty-three years. He issued the call and addressed the first gathering at which the American Society of Biological Chemists was founded, and formed the American Society for Pharmacology and Experimental Therapeutics. Here was something which he evidently regarded as of equal value to his research. Correspondence with many friends and acquaintances both in this country and in Europe was kept up during the whole long period of scientific activity. He knew how to take a true vacation, and dropped all work, and applied himself to this as intensely as he did to his scientific research.

The Universities of Michigan, Pittsburgh, Harvard, Yale, Lwow (Poland), Cambridge and Aberdeen conferred honorary degrees upon him. He was awarded the first Research Corporation prize, the Willard Gibbs, Conné and Kober medals and the medal of the Society of Apothecaries, London. A member of the National Academy of Sciences, honorary fellow or member of six American and fourteen foreign scientific societies, he received his last honor of Foreign Member of the Royal Society, London, the day of his death.

A mere description of the scientific work and numerous honors awarded him leaves one with a very incomplete and unsatisfactory picture of the man. The spirit of Abel was far greater than any of his scientific discoveries. He exercised a great influence on many pupils, assistants and others who came in contact with him during the course of his long scientific career; he served unconsciously as a very effective catalyst for the growth of scientific pharmacology in this country. He taught by example. None of the many who at one time or another were privileged to work in his laboratory failed to profit by his intense enthusiasm for his research, his youthful outlook on science, his tremendous optimism that the morrow would yield the coveted result, his fearlessness in engaging in difficult problems or in controversies, and above all the real simplicity of a very lovable man. None of these can forget the noon hour lunch table discussions where all the workers were thrown into intimate contact with "the Professor." Here the talk varied widely, sometimes largely shop talk, philosophical discussions, heated arguments, but above all a feeling of good fellowship with a certain amount of humor. The lift of the eyebrows and the merry twinkle in his eye as "the Professor" made some statement to provoke discussion will long be remembered by those who participated in these meetings. It was a special occasion when old pupils or assistants returned to lunch with the novitiates, to tell tales of the glories of the old days and anecdotes of the former conduct of their "Professor." Abel thoroughly enjoyed these luncheons and contributed largely to their success.

Despite his great absorption in his own major research problems of the moment, the door of his laboratory was always open to any worker in his laboratory or any former pupil or scientific friend. When one came for advice, one found a man who seemed to be

working against time, but one who was quite willing to stop to give advice to a younger colleague.

His research activities seemed to fill and permeate his whole life—he regarded research as a sacred torch to be kept burning at all times. In one of his addresses he writes: "Greater even than the greatest discovery is it to keep open the way to future discovery. This can only be done when the investigator freely dares, moved by an inner propulsion, to attack problems not because they give promise of immediate value to the human race, but because they make an irresistible appeal by reason of an inner beauty. . . . In short, there should be in research work a cultural character, an artistic quality, elements that give to painting, music and poetry their high place in the life of man."

A truly great international figure has passed. His many pupils, friends and acquaintances can not help but feel the loss, but can be reconciled to it by his long life of accomplishments and by the fact that he "died in harness" as he had wished.

The words of Socrates, which he once used to describe his old teacher Carl Ludwig, might well be said of John J. Abel. "A man whose desires are drawn towards knowledge in every form and who is therefore absorbed in the pleasures of the soul—one who is harmoniously constituted, who is not covetous or mean, or a boaster or a coward and can never therefore be unjust or hard in his dealings—he has no secret corner of meanness and is a searcher after and lover of the truth in all things."

He is survived by two sons, George H. Abel, of Philadelphia, and Robert Abel, of Boston.

E. K. MARSHALL, JR.

RECENT DEATHS

DR. BEVERLY T. GALLOWAY, who retired as pathologist of the Bureau of Plant Industry in 1933, died on June 13. He was in his seventy-fifth year.

DR. ROBERT MONTGOMERY BIRD, professor of organic chemistry at the University of Virginia, died on June 4 at the age of seventy-one years.

DR. GEORGE E. BURGET, for twenty years head of the department of physiology at the Medical School of the University of Oregon, died on June 4. A correspondent writes: "Dr. Burget's distinguished service to the school was not confined to his own department but permeated the entire school and community at large. It was felt especially in all scientific meetings and in the upbuilding of the Medical School Library. His presence was a great stimulus to productive scholarship and genuine research and the reverse to pseudo efforts."

BROTHER GEOFROY ARSÈNE BROUARD, of St. Michael's College, died at Santa Fe, New Mexico, on May 25, at the age of seventy-one years. A correspondent writes that "his collections of Mexican plants were among the most extensive and important ever assembled in that country. Especially noteworthy were his contributions to knowledge of mosses, hepatics and lichens, not only in Mexico but also in Louisiana and New Mexico."

DR. WILLIAM ARTHUR BONE, professor emeritus of chemical technology at the Imperial College of Science and Technology of the University of London and inventor of the Bone system of surface combustion, which he applied to industrial heating appliances, died on June 11. He was sixty-seven years old.

CHARLES FRANCIS MASSY SWYNNERTON and Dr. B. D. Buritt, of Tanganyika Territory, Africa, authorities on sleeping sickness, were killed in an airplane crash near Singida early in June. Mr. Swynnerton, who was director of tsetse fly research in Tanganyika, had devoted the last fifteen years to its study. Dr. Buritt was the government's tsetse research botanist.

SCIENTIFIC EVENTS

THE CAMBRIDGE MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE British Association for the Advancement of Science has issued a preliminary program for the annual meeting, which will be held at Cambridge from August 17 to 21 under the presidency of the Right Honorable Lord Rayleigh.

The inaugural general meeting will take place in the Regal Cinema, on Wednesday evening, August 17, when Lord Rayleigh will deliver the presidential address on "Natural Vision and Vision Aided by Science." The address will show how, taking the eye as a prototype, most of the observational methods of modern science may be regarded as derived from it by successive modifications. A further part of the address will deal with science and warfare and will be directed to show that the relation between them is of the nature of an accidental by-product, and has in no sense been the primary goal of investigation.

The presidential addresses before the sections are as follows:

A.—Dr. C. G. Darwin, on "Fundamentals in Physical Theory."

B.—Professor C. S. Gibson, on "Recent Investigations in the Chemistry of Gold."

C.—Professor H. H. Swinnerton, on "Development and Evolution."

D.—Dr. S. W. Kemp, on "The Future Development of Oceanography."

E.—Professor T. Griffith Taylor, on "Correlations and Culture, a Study of Technique."

F.—H. R. F. Harrod, on "Scope and Methods of Economics."

G.—Professor R. V. Southwell, on "The Changing Outlook of Engineering Science."

H.—Professor V. Gordon Childe, on "The Orient and Europe."

I.—There will be no meeting of this section on account of the simultaneous meeting of the International Physiological Congress at Zurich.

J.—Dr. R. H. Thouless, on "Eye and Brain as Factors in Visual Perception."

K.—Professor W. Stiles, on "The General Physiology of the Plant Cell and Its Importance for Pure and Applied Botany."

L.—J. Sargent, on "The Proper Function of Administration in Public Education."

Two evening discourses will be given, one by Dr. H. Godwin, on the "History of the Fens" and one by Professor M. L. Oliphant on "The Contribution of the Electrical Engineers to Modern Physics."

In the first statute adopted on the foundation of the association is this clause:

> . . . To obtain more general attention for the objects of science, and the removal of any disadvantages of a public kind which impede its progress.

The preliminary program states:

> Having in view these aims, the council, in cooperation with the sections, has considered the growing strength of the public demand for a more systematic presentation of selected subjects of scientific investigation in their bearing on the life of the community. Every item in the program potentially possesses such a bearing: The results of any scientific research may, immediately or ultimately, affect the public welfare. It is intended, however, to group together in a definite series each year certain communications in which the more immediate public interest will be stressed.

Exhibits will be arranged in various laboratories and an elaborate program of excursions to points of interest around Cambridge and visits to scientific institutions and industrial laboratories has been planned.

The third meeting of the British Association was held in Cambridge in 1833, the Rev. Professor Adam Sedgwick being president. Three subsequent meetings have been held there, in 1845 under the presidency of Sir John Herschel, in 1862 under that of the Rev. Professor R. Willis and in 1904 under that of the Right Honorable A. J. Balfour.

ASSEMBLY OF LABORATORY DIRECTORS AND SEROLOGISTS

PLANS are being developed for an assembly of laboratory workers interested in the control of syphilis, under the sponsorship of the Committee on Evaluation of Serodiagnostic Tests for Syphilis of the United States Public Health Service which has had the cooperation of the American Society of Clinical Pathologists. All such workers, both from private, hospital and public health laboratories, as well as physicians and health officers are invited to attend. Surgeon General Thomas Parran will be chairman of the assembly, which will be held on October 21 and 22, at Hot Springs National Park, Arkansas.

Its aims will be to consider means and methods to improve and to make more generally available the serologic tests, which are so important in syphilis control work. Tentative arrangements call for the presentation of the program in four sections.

The first section will consider the need for adherence to conventional technic in the routine performance of reliable serodiagnostic tests. This subject will be considered in papers by Drs. Harry Eagle, William A. Hinton, Reuben Kahn, Benjamin Kline and John A. Kolmer, with special reference to the tests which each of these workers has described.

Need for training of laboratory personnel will be the subject of the second section. The qualifications and training for both laboratory directors and technicians will be presented in separate papers.

The third section will discuss the prosecution of the studies to evaluate the performance of serologic tests within the states. The efficiency of branch state laboratories and of municipal, hospital and private laboratories can not be studied on a national basis. The subject is much too large. Should this be made a function of the state or large municipal department of health? Actual experience with such studies in the States of Maryland and New Jersey and in the City of Cleveland will be described.

The fourth section will consider the desirability of licensing or approving for the performance of serodiagnostic tests for syphilis, laboratories within the states by the respective state departments of health. This discussion will be conducted from the standpoint of the private laboratory director by Dr. Frederick H. Lamb, of Davenport, Iowa. The health officer's side will be presented by Dr. A. Wadsworth, State Department of Health, Albany, New York.

A separate committee will draft recommendations for each of the four sections for presentation to the assembly. The respective chairmen of these four section meetings will be Drs. Walter M. Simpson, Dayton, Ohio; Arthur H. Sanford, Rochester, Minn.; F. E. Senear, Chicago, and H. H. Hazen, Washington, D. C.

General discussion will follow the presentation of each set of recommendations.

An additional feature of the meeting will be an actual demonstration of the performance of the Eagle, Hinton, Kahn, Kline, and Kolmer tests by the originators of these procedures.

Those interested in obtaining further information should write to the Surgeon General, U. S. Public Health Service, Washington, D. C.

THE DEPARTMENT OF NEUROPSYCHIATRY AT WASHINGTON UNIVERSITY, ST. LOUIS

A NEW department of neuropsychiatry that will conduct an intensive study of mental and nervous diseases in the hospitals and clinics affiliated with the Medical School of Washington University, St. Louis, has been made possible by a grant of $150,000 from the Rockefeller Foundation. Three professors have been appointed, each of whom will direct a division of the department. Dr. David M. Rioch, associate professor of anatomy at the Harvard Medical School, will become professor of neurology and administrative head of the department; Dr. John C. Whitehorn, director of the laboratories at McLean Hospital, Boston, will be professor of psychiatry, and Dr. Carlyle F. Jacobsen, assistant professor of psychology at the Cornell University Medical School and psychiatrist in the Payne Whitney Clinic, will be professor of medical psychology. Dr. Sidney I. Schwab, professor of clinical neurology and for many years head of the department in the Medical School, will continue his work in the new department, as will other members of the present staff.

In a statement issued by Dr. Philip A. Shaffer, dean of the Medical School, he said in part:

> The establishment of this department is one more major step toward the creation in St. Louis of a great medical center of which the School of Medicine is the nucleus. During the past twenty-five years there has grown up a group of affiliated hospitals and departments of the medical school which collectively have become widely known as a leading center for medical research and teaching and for the practice of progressive methods of medical treatment. With the generous aid of a number of donors from this community, supplemented by large gifts from the Rockefeller Foundation and its affiliated General Education Board, one department after another has been put upon a sound basis, staffed by a corps of competent specialists, most of whom devote their full time to teaching and research. The essential departments concerned with the study of bodily structure and function, and with the application of this information to disease, have been provided.
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> Realizing the importance of greater progress in this direction the Rockefeller Foundation is now devoting a portion of its large resources to an intensive study of nervous and mental disease. Several of the foremost medical schools, of which Washington University is one, have received grants from the foundation for this purpose. One reason why the Rockefeller Foundation has selected the Washington University School of Medicine as a center for a development in neuropsychiatry is the notable achievements already made in this Medical School in the study of the mechanism of nervous impulses and the behavior of the nervous system. Largely as a result of fundamental and widely known work done some years ago by Dr. Joseph Erlanger, professor of physiology, and Dr. Herbert S. Gasser, then professor of pharmacology and now the director of the Rockefeller Institute, many other members of the staff have become active in this very difficult field, and in consequence the Medical School is now regarded as a principal center for the study of nerve physiology. Besides Dr. Erlanger, Drs. George Bishop, James O'Leary, Peter Heinbecker, H. T. Graham, F. O. Schmitt and their associates have made notable contributions to this subject.

IN HONOR OF PROFESSOR SCHUCHERT

To mark the eightieth birthday of Professor Charles Schuchert, professor of paleontology emeritus in Yale University, his former students have presented to the Peabody Museum of Natural History a portrait of him painted by Professor Deane Keller, of the Yale School of the Fine Arts. Although the actual birthday date is July 3, the presentation of the portrait to the museum took place on June 17, in order that more of his students and his colleagues might be present. The portrait represents him in an attitude that will be familiar to his students, seated at a table, with a fossil brachiopod in one hand and in the other a small hand lens that he has used for many years. In the background are shelves of books and on the wall one of his paleogeographic maps, showing the distribution of lands and seas at an early period in the earth's history.

At the presentation ceremony, which took place in the Hall of Man at the Peabody Museum, the speakers were introduced by Professor Carl O. Dunbar, who succeeded Professor Schuchert in the chair of paleontology and stratigraphy, and who took his doctorate under him in 1917. Following him, Professor William H. Twenhofel, of the University of Wisconsin, B.A., Yale, '08, Ph.D., '12, spoke of the personal relations between Professor Schuchert and his students, and at the close of his talk the portrait was presented to the museum. It will hang with those of George Peabody, founder of the museum; O. C. Marsh, professor of paleontology from 1866 to 1899, and Colonel George Gibbs, whose mineral collection was one of the earliest to be acquired by the museum. The portrait was accepted by Dr. Albert Eide Parr, director of the museum.

SCIENTIFIC NOTES AND NEWS

DR. RUDOLPH MATAS, professor emeritus of vascular surgery at Tulane University, was given the first distinguished service award of the American Medical Association at the San Francisco meeting.

THE medal in ophthalmology of the University of Buffalo has been awarded to Dr. John Bellows, of the Medical School of Northwestern University, for his paper entitled "Biochemical Studies on the Crystalline Lens." This medal is awarded "for outstanding work in ophthalmology."

THE Daniel Guggenheim Medal for 1938 has been awarded to A. H. R. Fedden, chief engineer of the Bristol Aeroplane Company, of England, "for contributions to the development of aircraft engine design and for specific design of the sleeve valve aircraft engine."

DR. JOHN H. DELLINGER, chief of the radio section of the National Bureau of Standards in Washington, received the gold medal of honor of the Institute of Radio Engineers at the opening of the thirteenth annual convention of the institute in New York City on June 16. The Morris Liebmann memorial prize of $290 was given to George C. Southworth, of the Bell Telephone Laboratories, for his work on ultra-high-frequency waves. Arthur L. Samuel, also of the Bell Telephone Laboratories, received an award of $100 for the best paper published in the *Proceedings* of the institute during 1937.

A SPECIAL supplementary number of the *Journal of Geology* in honor of Professor Emeritus Albert Johannsen, of the University of Chicago, has been issued in recognition of his work in petrography and the crystalline structure of igneous rocks. Dr. Johannsen retired in March, 1937, after serving the university for twenty-seven years. He was an editor of the *Journal of Geology* for nearly thirty years. The volume contains studies by leading workers in his field, including geologists in the universities of Uppsala and Sparreholm, Sweden; Heidelberg and Halle, Germany, and Helsinki, Finland.

THE University of Pennsylvania conferred on June 15 the degree of doctor of laws on Dr. James R. Angell, president emeritus of Yale University, previously professor of psychology at the University of Chicago and now educational counsellor of the National Broadcasting Company.

THE doctorate of science was conferred at the commencement of Lafayette College on Dr. Oliver Hazard Perry Pepper, professor of medicine at the University of Pennsylvania, president of the American Association of Physicians.

THE University of Western Ontario at London, Canada, conferred on June 1 the doctorate of laws on Dr. Henry Asbury Christian, Hersey professor of the theory and practice of physic at Harvard University, who gave the commencement address.

THE doctorate of science was conferred by Rutgers University on June 12 on Dr. Gano Dunn, of New York City, for "achievement in electrical engineering," and on Lincoln Ellsworth, polar explorer.

AT the commencement exercises at the Rose Polytechnic Institute on June 4 the address was given by President Harvey N. Davis, of the Stevens Institute of Technology, and honorary degrees of doctor of engineering were conferred on Dr. Davis and on John Boudinot Hunley, the bridge engineer.

AT the sixty-seventh annual commencement of Syracuse University the doctorate of laws was conferred on Dr. Ferdinand A. Silcox, chief of the U. S. Forest Service.

THE University of North Carolina on June 7 conferred its doctorate of laws on C. S. Brimley, of the division of entomology of the North Carolina Department of Agriculture.

THE degree of doctor of laws was conferred on June 4 by Santa Clara University, San Jose, Calif., on Dr. J. C. Geiger, director of the Department of Public Health of the City and County of San Francisco.

AN honorary degree was conferred on Dr. Robert A. Millikan, chairman of the executive council of the California Institute of Technology, at the seventy-second commencement of Loyola University, Los Angeles.

THE Case chapter of the Society of Sigma Xi, Cleveland, has elected the following officers: *President,* Professor G. E. Barnes; *Vice-president,* Professor Francis Whitacre; *Treasurer,* Dean T. M. Focke, and *Secretary,* Professor Richard S. Burington.

PROFESSOR JOHN B. WHITEHEAD, formerly dean, has been appointed director of the School of Engineering of the Johns Hopkins University, and Professor William B. Kouwenhoven, formerly assistant dean, has been appointed dean.

DR. ROBERT J. TRUMPLER, of the Lick Observatory, has been appointed professor of astronomy in the department of astronomy of the University of California at Berkeley. He succeeds Dr. A. O. Leuschner, whose retirement has been announced. Dr. R. T. Crawford has been appointed chairman of the department.

IN the Medical School of New York University, Dr. Richard P. Hall has been promoted to a professorship

of biology, and Dr. Thomas A. Gonzales, chief medical examiner of New York City, to a professorship of forensic medicine. In the School of Engineering, Arthur C. Coonradt has been advanced to a professorship of mechanical engineering and David B. Porter to a professorship of industrial engineering.

DR. EDWIN E. HEIZER, assistant professor at the Ohio State University, has been appointed head of the newly established department of dairy husbandry in the College of Agriculture at the University of Wisconsin.

MRS. EVELYN CARROLL RUSK, professor of mathematics at Wells College, Aurora, N. Y., has been appointed dean of the college.

DR. H. BURR STEINBACH, of the University of Minnesota, has been appointed assistant professor of zoology at Columbia University; Dr. K. W. Cooper, of the department of zoology of Columbia University, has been appointed instructor in the department of zoology at the University of Rochester.

DR. FOSTER F. RIEKE, of the Johns Hopkins University, and Dr. Charles S. French, Austin teaching fellow in biochemistry at Harvard University, have been appointed research instructors in chemistry at the University of Chicago. They will assist Dr. James Franck, who has accepted the professorship of physical chemistry. The Samuel B. Fels Fund of Philadelphia recently provided $212,000 to support Dr. Franck's work.

DR. HARRY SOBOTKA, chemist to the Mount Sinai Hospital, New York, has received a grant from the Committee on Scientific Research of the American Medical Association for studies on "Monomolecular Layers of Physiologically Active Substances." Dr. Elizabeth Shull Russell, of the Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine, has received a grant to continue work on the genetics of tumors in *Drosophila melanogaster*.

DR. ISAIAH BOWMAN, president of the Johns Hopkins University, will be the chairman of the American delegation to the forthcoming International Geographical Congress, to be held at Amsterdam from July 18 to 28.

DR. M. A. BIGELOW, professor of biology in Teachers College, Columbia University, has recently returned from a four months' field trip under the auspices of the American Social Science Association. In addition to attending a number of conferences arranged by state health societies, he visited colleges in the southern states, held conferences with members of faculties and gave lectures and addresses on the social hygiene movement.

SIR THOMAS MIDDLETON has been elected chairman of the British Agricultural Research Council in effect on July 1, when Lord Richard Cavendish, who has been chairman of the council since its establishment in 1931, retires from membership of the council. Sir Thomas Middleton, who has been vice-chairman of the Development Commission since 1929, has been a member of the council since 1931. He is chairman of the Standing Committee of the Council on Soils and Plant Nutrition and of the Committee on the Estimates of Research Institutions.

DR. H. J. GOUGH, superintendent of the department of engineering of the National Physical Laboratory, has been appointed to the new post of director of scientific research at the British War Office.

DR. EDWIN P. HUBBLE, of the Mt. Wilson Observatory, was the principal speaker at the forty-second commencement exercises of the California Institute of Technology.

PROTEIN CHEMISTRY is the subject of the sixth of the Cold Spring Harbor Symposia on Quantitative Biology, to be held from June 22 to July 21 at the Biological Laboratory, Cold Spring Harbor, L. I. Papers will be presented by the following: W. T. Astbury, L. G. Barth, Richard J. Block, Henry B. Bull, R. Keith Cannan, Dwight Carpenter, E. J. Cohn, J. F. Danielli, Vincent du Vigneaud, John T. Edsall, Hugo Fricke, Joseph S. Fruton, G. Grabar, Samuel Graff, Michael Heidelberger, R. M. Herbst, Roger Herriott, Eloise Jameson, Forrest E. Kendall, M. Kunitz, Irving Langmuir, H. S. Loring, John W. Mehl, Karl Meyer, Alfred E. Mirsky, Laurence S. Moyer, Hans Neurath, Carl Niemann, W. M. Stanley, Jacinto Steinhardt, Kurt G. Stern, H. B. Vickery, Abraham White, J. W. Williams, Dorothy Wrinch, R. W. G. Wyckoff. Programs can be obtained from the Biological Laboratory.

AMONG those who will take part in the Symposium on Theoretical Physics, which is to be held at the University of Michigan from June 27 to August 19, are Professor H. A. Kramers, of the University of Leiden, who will lecture throughout the session on "Relativity and Spin" and on the "Radiation Theory"; Professor P. P. Ewald, of the University of Cambridge, England, will lecture on "Multiple Reflection of X-rays in Crystals" and on "How to Look at Crystal Structure Determinations" on June 29 and 30; Professor Gregory Breit, of the University of Wisconsin, on "Nuclear Forces" from July 11 to August 5; Professor H. A. Bethe, of Cornell University, on "Selected Topics in Nuclear Physics," from June 27 to July 15; Assistant Professor E. Bright Wilson, Jr., of Harvard University, on "Chemical Interpretation of Infrared

and Raman Spectra," from July 25 to August 6, and Dr. Frederick Seitz, of the Research Laboratories of the General Electric Company, on "The Theory of the Solid State," from August 1 to August 12.

A NATIONAL Health Conference will be held in Washington, D. C., from July 18 to 20, under the direction of the Departmental Committee to Coordinate Health and Welfare Activities. The conference has been called at the suggestion of President Roosevelt after three years of preliminary work by the interdepartmental committee. It is hoped to be able to formulate policies for the cooperation of the medical and other professions, private organizations, federal, state and local agencies and individual citizens. About one hundred representatives of the medical and other professions, organizations interested in provision for medical service, labor, agriculture and other groups of citizens will attend. Josephine Roche, formerly assistant secretary of the treasury, is chairman of the interdepartmental committee, which consists of officials of the Social Security Board and the Treasury, Agriculture, Interior and Labor Departments. It was appointed by the President on August 15, 1935.

THE Western Division of the American Mining Congress will hold its fifth anuual Metal Mining Convention and Exposition at the Ambassador Hotel, Los Angeles, from October 24 to 27. There will be addresses by noted industrialists and other public leaders, papers on operating problems and a series of exhibits showing the latest and most efficient equipment for metal mining and preparation for commercial use.

THE Allegany School of Natural History will open its twelfth session in Allegany State Park on July 3. Dr. Robert B. Gordon, assistant professor of botany at the Ohio State University, is director. The school is conducted by the Buffalo Society of Natural Sciences in cooperation with the University of Buffalo and the Allegany State Park Commission. It is situated in the park, which has 65,000 acres of woods, mountains and streams.

Museum News reports that the Fairchild Tropical Garden, Coral Gables, Florida, was dedicated recently with addresses by David Fairchild, for whom the garden has been named; Dr. Elmer D. Merrill, administrator of botanical collections of Harvard University; Walter T. Swingle, Bureau of Plant Industry, U. S. Department of Agriculture, and L. H. Bailey, Bailey Hortorium, New York College of Agriculture. The garden contains several hundred acres of land with three varieties of soil—high land, hammock (forest) land, and low land. Twenty-five acres owned by the garden will be known as the Montgomery Palmetum, with mango, avocado and citrus, also mammea apple and live oaks. This twenty-five acres and fifty-eight additional acres were given by Colonel and Mrs. Robert H. Montgomery; the remainder of the land was contributed by the Dade County Commissioners, who retain title to all but the twenty-five acres. Colonel and Mrs. Montgomery have given, in addition to land, more than 200 species of palms and flowering trees with funds for planting and for roads, walls, etc., in the twenty-five acre tract. Plans for the garden have been prepared by William Lyman Phillips, in consultation with Noel Chamberlain. K. Dahlberg is superintendent, and A. C. Jordahn, associate superintendent.

PROVISION has been made for the continuance through 1938 of the projects of the Works Progress Administration under way at the Field Museum of Natural History, Chicago. The projects this year will employ approximately 200 persons, and will be conducted along the same lines as those of 1937. Last year the number ranged from 167 to 199; their aggregate working time amounted to 240,000 hours; and the total amount of wages paid to them was $174,200. Although the efforts of the WPA workers have been utilized chiefly in routine tasks there is said to have been a large number of workers who have proved capable of scientific research undertakings, artistic work and other activities calling for knowledge, training and skill and talent. Some were qualified by past experience, while others, possessing native ability, were trained at the museum. This group has contributed to the museum's scientific publications, to the preparation of new exhibits, the making of maps and charts and the binding of books in the library. It is emphasized that no regular employee on the payroll of the museum has been displaced by the employment of WPA workers.

THE National Hospital, Queen Square, London, which is a research center in neurology, has, according to the London *Times*, long been hampered in its work by lack of space and equipment. It is now proposed to rebuild the hospital, which was established in 1859, and provide new departments for the study and cure of nervous diseases. Sir George Broadbridge, chairman of the appeal committee of the hospital, recently made a statement to the effect that the Rockefeller Trustees had recognized the importance of the work done there and the difficulties under which it was carried out. They had offered £60,000 towards building new laboratories, research department and surgical and medical wards, and £60,000 towards the endowment of research on condition that the British public subscribed the remaining cost of those buildings and their equipment in the near future. In addition a new nurses' home was required.

The new buildings were estimated to cost £180,000. The hospital was therefore appealing for a sum of £120,000. The grant by the Rockefeller Trustees, he added, was a great tribute to the hospital and a noble gesture of international good will. If the appeal were successful the hospital would be enabled to build modern laboratories, lecture and teaching rooms, operation theaters with x-ray room attached and surgical and medical wards for special cases under research observation. It was also desired to provide private nursing rooms for pay-patients of moderate means and a new nurses' home.

DISCUSSION

AMERICANS AND THE ROYAL ASTRONOMICAL SOCIETY

THE development of American astronomy has an international side, and therefore, the biography and the history of science can profit by the study of its relation with organized astronomy abroad. In this connection, the publications, minutes of meetings and the files of the Royal Astronomical Society, London, founded in 1820, are not without interest.

In the list of associates of the society, an honor given to foreign astronomers, Nathaniel Bowditch is the first American, elected in 1829. The proposers were weak in details:

Astronomical Society of London

We, the undersigned, having a personal knowledge of and being acquainted with the works of Professor [Nathaniel—filled in with pencil] Bowditch of Boston in Connecticut, U. S. Author of a treatise on Navigation and translator of the Mécanique Céleste into English which he is now publishing with notes believe him to be a person eminent in the [field?] of Astronomy, and therefore propose and recommend him as a proper person to become an associate of the Astronomical Society of London.

Witness our hand this 13th day of February 1829.

W. H. Shirreff
J. F. W. Hershel
J. South.

Proposed March 13, 1829.
Elected May 8, 1829.

Ferdinand Hassler was elected the following year, having been proposed by J. L. Tiarks, Edw. Troughton, Richard Sheepshanks, F. Beaufort, Francis Bailey, Davies Gilbert and J. South. He had attracted their attention by his work on the Coast Survey, his publications on trigonometry and a "popular system" of astronomy.[1]

But the council reported with regret to the society on February 14, 1834, that no steps have been taken in America to encourage the science of astronomy, and that the hope expressed by the president, Francis Bailey, in 1825 had been disappointed. There should be a public observatory.[2] By 1847 the council had reported that the apathy no longer prevailed.[3] They were especially delighted with the equatorial telescope, with a 12-inch aperture, that Cincinnati had acquired. They followed closely the work at the Naval Observatory and Harvard. At a meeting on December 14, 1849, the president and astronomer royal gave an oral statement "On the Method of observing and recording Transits, lately introduced in America. . . ."[4] He said:

> The Americans of the United States, although late in the field of astronomical enterprise, have now taken up that science with their characteristic energy, and have already shown their ability to instruct their former masters.

As R. A. Sampson writes, it is the decade 1840 to 1850 when American observatories and workers come definitely into the society's field of view.[5] W. C. Bond was made an associate in 1849, and soon was joined by his compatriots: B. Peirce, A. D. Bache, O. M. Mitchel, S. C. Walker, Maury and Brunnow.[6] In the early years, and up to 1856, an associate was recommended for election not only in recognition of his past achievements, but also in the hope of his future service. He was to cooperate with the society, and thus, official positions counted for much.

In 1858, 7 out of 52 associates were American; in 1901, 14 out of 43; in 1934, 20 out of a list of 45. From the origin of the society I count 59 American associates. The interchange of ideas, of course, is also forwarded by Americans on the List of Fellows.

The list of the Americans to receive the high honor of the society's gold medal is given below. Professor G. P. Bond was the first to receive it. Bond had visited Europe in 1851 and 1863, and had become known to the council by his "Annals of the Astronomical Observatory of Harvard College," volume III. Special mention was made to his application of photography to astronomical observations.[7]

G. P. Bond	—1865
Simon Newcomb	—1874
Asaph Hall	—1879
B. A. Gould	—1883

[1] Mss. certificate.

[2] *Monthly Notices of the Royal Astronomical Society*, v. 3, p. 30; *Memoirs of the R.A.S.*, v. 2, p. 25.

[3] *Monthly Notices*, v. 7, 225–226.

[4] *Monthly Notices*, v. 10, p. 26.

[5] "History of the R.A.S.," London, 1923, by various writers. The statement, p. 105, that Bond is the first American Associate is not correct.

[6] The obituary notices throughout the *Monthly Notices* are revealing. See especially that of W. C. Bond, v. 20, p. 118.

[7] *Monthly Notices*, v. 25, pp. 125–137. The course of astronomy in the U. S. as it appeared to the British can be followed in presentation addresses and elsewhere in the *Monthly Notices*. Three general indexes are useful.

Henry Draper	—1884
E. C. Pickering	—1886, 1901
S. C. Chandler	—1896
E. E. Barnard	—1897
G. E. Hale	—1904
W. W. Campbell	1906
W. S. Adams	—1917
H. N. Russell	—1921
A. A. Michelson	—1923
F. Schlesinger	—1927
R. G. Aitken	—1932
V. M. Slipher	—1933
Harlow Shapley	—1934

The dates may offer material for speculation on the part of the reader. The contacts, outside the realm of the organizations, as for example, the interesting correspondence of Sir David Gill and Simon Newcomb, are another and longer chronicle.

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THE FIRST KNOWN LONG MATHEMATICAL DECLINE

WHILE mathematical attainments have usually been preserved and increased from generation to generation there have also been periods during which not only no important progress was made but many of the earlier achievements were temporarily forgotten. The earliest known such long period relates to the ancient Babylonians and started about 2000 B.C. According to the recent volume 3, page 25, of the favorably known "Geschichte der Elementar-Mathematik," by J. Tropfke, there was a period of 1,500 years during which no cuneiform texts are now known which include the solving of equations. In particular, the known solutions of quadratic equations, which are however restricted to the determinations of only one root according to most students of the subject, originated during two periods of time about the year 2000 B.C. and 200 B.C., respectively.

There is still considerable uncertainty in regard to the mathematical attainments of the ancient Sumerians and the ancient Babylonians, but enough has recently been discovered to show that our histories of mathematics which were published about a dozen years ago are in need of many modifications as regards ancient mathematics. In particular, the quadratic equation was treated on 27 pages in the preceding edition (1922) of the volume to which we referred in the preceding paragraph, while 68 pages are devoted to the same equation in this volume and much of this increase is due to the recent discoveries by O. Neugebauer and others in regard to the mathematics of the ancient Sumerians and the ancient Babylonians.

It should not be inferred that the first known mathematical decline started from a high state of mathematical attainments. The later attainments of the ancient Greeks were of a much higher order than those which had been reached by the ancient Sumerians and the ancient Babylonians. General methods for solving the quadratic equation represent the peak of this early advance, and these methods were then only partially understood since the number concepts had not yet been developed so as to include complex numbers. Even the ancient Greeks failed to reach a sufficiently high mathematical advance to master the solution of the quadratic equation, although they got much further in this direction than their predecessors. Their work, too, was followed by a long mathematical decline, which was again followed by an advance. The latter reached a sufficient point to really master the solution of the quadratic equation as it is now taught in our high schools.

Until recently the study of the civilizations preceding that of the ancient Greeks required very meager mathematical knowledge, but the recent discoveries relating to the mathematics of the ancient Babylonians and the ancient Egyptians have effected a considerable change in this direction. It is now necessary to know fully the difficulties involved in the solution of the quadratic equation in order to evaluate the intellectual advances made by the ancients before the times of Greeks. From the standpoint of modern mathematics this is still meager, but it is a great advance beyond the fundamental operations with positive rational numbers. In particular, it has recently been discovered that such rules in multiplication as − times − is plus, and − times + is minus were already used by the ancient Babylonians.

There has been considerable discussion in regard to the question whether the ancient Babylonian mathematics preceding the long decline in question should be regarded as extending into algebra. Since no generally accepted definition of the term algebra now exists it is clearly impossible to decide this question in a satisfactory manner. One of the most senseless efforts to distinguish between arithmetic and algebra appears in Webster's "New International Dictionary" (1938) under the entry "algebra" in the following words: "The essential difference between arithmetic and algebra is that the former deals with concrete quantities while the latter deals with symbols whose values may be any out of a given number field."

Even the ancient Babylonian arithmetic which preceded the noted long decline dealt mainly with abstract numbers according to their extant literature. One of the chief objectives of pre-Grecian mathematics was the development of methods to perform the fundamental operations with respect to number aggregates composed of the positive rational abstract numbers. It

seems probable that integers were used before the common fractions were employed, but the fact that in our modern languages the number one-half has a name which is independent of the name for two points to the very early use of common fractions. The scale downwards from unity was probably almost as important in the early steps towards civilization as the scale upwards, but such questions can obviously never be decided from historical evidences.

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CROSS REFERENCES IN SCIENTIFIC LITERATURE

THE effective compilation of data is almost inevitably complicated by the necessity of a suitable means of indicating cross references. Since the secretarial work involved often becomes burdensome, the following system is suggested:

References are taken on standard size index cards, the six by four inch cards being very satisfactory. These are filed alphabetically according to the name of the author. The subject being investigated is divided into appropriate topics and a key card is prepared. The top margin of the key card is divided into vertical spaces about one fourth inch apart, and a topic assigned to each space so provided. If, for example, the first topic selected is "the reaction of the culture media," all cards treating this subject will be marked on the upper margin one fourth inch from the left margin. If "culture characteristics" is the next topic, all references concerning this subject will be marked one half inch from the left margin. "Scotch tape" in various colors, red, blue and green can be used to mark the upper margin of each card. If a reference card contains information concerning more than one of the topics suggested it may be marked in as many places as necessary on the upper margin. The use of various colors makes it possible to divide the upper margin into more spaces than would otherwise be possible. If three colors are used there will be a repetition of one color every three fourths of an inch. Brass paper clips were previously used but the top margin of the cards was so thickened that the index became unwieldy. In addition to the variety of colors, the "Scotch tape" has the advantages of being thin and its use on the card does not cause the upper margins to become unduly thick. The number of cross references is limited by the size of the index card, but the simplicity makes an effective system possible with a minimum amount of effort.

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OVEREXERTION AS CAUSE OF DEATH OF CAPTURED FISH

MOST kinds of fishes die very quickly when removed from the water. As an example, herring on being taken out of the water flop about very vigorously and die in a few minutes with the symptoms of asphyxia. Some kinds, however, remain alive for a considerable time under such conditions. The eel (*Anguilla*) may remain alive for days out of water in moist situations, and the same is true for the catfish (*Ameiurus*). Since the obvious changes in the dying fish are those associated with suffocation in air-breathing vertebrates, such as mammals and birds, and since the fish is out of its natural environment, water, for which its respiratory mechanism is suitable, it is natural to conclude that the death of the fish is due to interference with respiration. Nevertheless, proof has been lacking that in air the gills are less able to transmit oxygen to, and remove carbon dioxide from, the blood than when they are in water.

As a matter of fact, death occurs in many captured fish, such as herring, even when they are not removed from the water. Herring do not survive very long when caught in nets, whose meshes permit them to pass through as far as the dorsal fin, but no farther. Although the fish are said to be gilled since the gills prevent them from backing out, there is no interference with respiration, the net holding them by the middle of the body. Among sea fish that are taken regularly by baited hooks on set lines (the "long lines" of British fishermen and the "bultows" or "trawls" of fishermen on the western side of the North Atlantic), the haddock is one that dies very quickly whether removed from the water or merely caught and held. It may be maintained that, with a hook in its mouth, the haddock is unable to breathe properly, but I have failed to get evidence that this is true.

Ritchie,[1] in studying *rigor mortis* in fish, particularly members of the cod family (*Gadidae*), found captured haddock, cod and hake (*Urophycis*) to have 0.15, 0.08 and 0.05 per cent. respectively of lactic acid in their muscles, representing increases above the amount in resting muscle due to various degrees of fatigue. The differences in degree of fatigue between the three species was considered to correspond with differences in the "usual notion of their muscular activity." Macleod and Simpson[2] found that haddock captured on "trawls" and examined within 2½ hours after being hooked had practically no glycogen in the muscles, but those taken quickly on hand lines had from 0.04 to 0.22 per cent., the difference being attributed to more struggling when a long time on the "trawls." The absence of glycogen would be due to

[1] A. D. Ritchie, *Jour. Physiol.*, 60: 1–2, 1925.
[2] J. J. R. Macleod and W. W. Simpson, *Contr. Can. Biol. N. S.*, 3: 439–456, 1927.

its conversion into lactic acid, but since the amounts of lactic acid in the muscle of haddock taken on the "trawls" was little if any greater than those of haddock taken by hand lines, it is inferred that the lactic acid was being removed by the blood. Buddenbrock[3] finds that there is a high concentration of lactic acid in the blood of cod that have been captured and placed in an aquarium, and that, both directly and through its effect on the cell membrane and shape of the erythrocytes, lactic acid reduces the oxygen-carrying power of the blood. This causes a vicious circle, since the oxygen is required to remove the lactic acid, and its lack results in a further increase in the lactic acid.

It can now be readily understood why very nervous fish, such as herring and haddock, die so quickly when captured, and sluggish fish, such as the eel and the catfish, live so much longer under similar conditions. The rapidity of death seems definitely related to the degree of struggling or muscle activity on capture. It is evident that overexertion of the fish converts all the glycogen of the muscle into lactic acid, which passes into the blood and reduces the oxygen-carrying capacity of the latter. This results in asphyxiation of the cells of the nervous system, which undergo irreversible changes. At the Atlantic Biological Station, St. Andrews, New Brunswick, success was achieved in keeping herring and haddock alive in aquaria, when on capture their struggling was reduced to a minimum.

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SCIENTIFIC BOOKS

MEN OF MATHEMATICS

Men of Mathematics. By E. T. BELL. Simon and Schuster, New York, 1937. xvi + 592 pp. $5.00.

IF one thumbs the numerous cards for Eric Temple Bell in the Harvard College Library, one finds intermingled with those representing his mathematical work some endorsed "John Taine, pseud." and representing something else—"thrillers." Thus does a great library override the author's modest pseudonymity. The Jekyll-Hyde characteristics of the Bell-Taine contributions are both present in Bell's "Men of Mathematics," but what part of the work will be attributed to Jekyll and what to Hyde will vary with the reader. For that large number of the somewhat general public to which Simon and Schuster cater in some of their publications it will be Dr. Jekyll who writes the "heart-interest" material and the glittering generalities in an often loose style and it will be Mr. Hyde who tries to expound the theory of algebraic ideals or of transfinite numbers or of symbolic logic, whereas for the professional mathematician the attribution for these respective parts will be inverted. As the book has been widely read and perhaps not always discriminatingly reviewed, it may be permitted that I concentrate unduly upon some of the things on which I would raise questions.

Of Poincaré it is written (p. 546): "He had the misfortune to be in his prime just when physics had reached one of its recurrent periods of senility, and he was so thoroughly saturated with nineteenth century theories when physics began to recover its youth—after Planck, in 1900, and Einstein, in 1905, had performed the difficult and delicate operation of endowing the decrepit roué with its first pair of new glands—that he had barely time to digest the miracle before his death in 1912."

Passing over the use of "recurrent" with so progressive a condition as "senility," one may raise a question as to the jump from that to "roué," and the further question as to who were the women in the case—was the "queen of the sciences among them? Then with respect to the medical or surgical references, is it an accepted fact that the Steinach or similar operations do renew the youth of decrepit roué's? Or is this just "fine writing"? Furthermore, when was Poincaré in his prime and what was physics doing around that time? He was not thirty when Gibbs's thermodynamic papers, over which Maxwell was enthusiastic, were published. He was in his thirties when Arrhenius and Oswald were establishing important results in the same field, when Heaviside's best work on telephony was done and Hertz discovered his wireless waves. He was barely forty when x-rays, electrons and radioactivity came actively on the scene and Lorentz was making great contributions. The author does not seem to realize that it was such high activity and buoyant youth in physics which made Planck and Einstein possible as Faraday's work had made Maxwell possible.

On p. 168: "Without the science of chemistry soap is impossible." As my maternal grandmother used to say—I want to know! Page 24: "For penetrating subtlety of thought we shall not meet his (Zeno's) equal till we reach the twentieth century and encounter Brouwer." There were some pretty subtle thinkers in between. Page 108: "Mathematics, dynamics, and celestial mechanics were in fact—we may as well admit it—secondary interests with Newton. His heart was in his alchemy, his researches in chronology, and his theological studies." It is said that when a complaint was made to Lincoln that Grant drank whiskey, Lincoln asked that the brand be ascertained so that he could get some of the same for his other generals. Page 95: "For in Newton's day alchemy *was* chem-

[3] W. v. Buddenbrock, *Cons. Int. Explor. Mer. Rapp. Proc.-Verb.*, 101 (IV_2): 1–7, 1938.

istry"—the historians of chemistry seem to doubt this as they do the reference to soap. Pp. 934: "In accepting the call (to Johns Hopkins in 1876) Sylvester made one curious stipulation; his salary was 'to be paid in gold.'" *Sic!* Did Sylvester perhaps know more of the current monetary situation than the author seems to? Page 27: "Apollonius is without a peer till Steiner." Some might put in a word for some intervening geometer, though, of course, all such judgments are matters of opinion rather than of fact. Page 446: "The work of Whitehead and Russell in *Principia Mathematica* (1910–1913) was the first to convince any considerable body of professional mathematicians that symbolic logic might be worth their serious attention." It is perhaps clear that the author does not hesitate to express his opinions on a wide range of subjects! I will omit reference to his equally definitely expressed social judgments (*e.g.*, p. 112, ll. 2–3; p. 131, ll. 2–4; p. 130, final ¶; p. 114, ll. 9–14 up)—I am not a competent psychoanalyst.

On pp. 209–212 the author undertakes to explain the "principle of continuity" in geometry. He has here to introduce a variety of concepts, including points at infinity and imaginary points. His illustration is to pull two intersecting real circles apart; he confuses the two finite points of intersection which persist during the process with the two imaginary points at infinity in which the circles intersect whether they cut in real or in finite imaginary points. It is just too bad. While he seems to approve of the principle of continuity as of heuristic value, when he comes to the corresponding algebraic principle he writes (p. 355): "The climax of this credulity was reached in the notorious *principle of permanence of form, . . .*" Is this because he is an algebraist rather than a geometer? We have a way of tolerating suggestive heuristic methods in the matters we know not well but of detesting them in our specialities. It has always been my belief that the geometric principle of continuity and the algebraic principle of permanence of form were essentially correlative, and found a large measure of justification in certain theorems of the theory of analytic functions relating to analytic extension.

The author likes to jolly his reader along as when (p. 5): "As to the amount of mathematical knowledge necessary to understand *everything* . . . it may be said honestly that a high school course is sufficient," or (p. 444) in reference to a 30-page paper by Huntington: "The whole paper is easily understandable by anyone who has had a week of algebra." This is of course ridiculous. Omitting the fact that the author has written of many things he understood all too little himself, it may be pointed out that abstraction of thinking is difficult as one knows when he has had about a week of algebra or, later, when he has had a week or two of vector analysis, and we may well recall that Kummer, apparently one of Bell's greatest heroes, was responsible for Grassmann's not getting a university position because forsooth he did not really understand the Ausdehnunglehre, the whole of which might be said to need "only a few weeks of algebra and of geometry." Incidentally, Grassmann might have been an interesting case to include in "Men of Mathematics"—his was not the pathetic and perhaps psychopathic history of Galois, for he lived on, raised a family and became as well known for his contributions to Sanscrit and for Grassmann's law in phonetics as he later became for his earlier contributions to mathematics.

There are numerous references to Einstein. One can appreciate their "sales value." I can not comment on them all but will raise a question relative to the statements on the top of p. 256. From as early as 1907 to as late as 1912 Einstein was publishing on gravitation, formulating and using his "equivalence-principle" without giving much evidence that he was mastering the tensor calculus—that came later in a joint paper with M. Grossmann—and whether he as a theoretical physicist would have been interested in the intricacies of the tensor calculus if he had happened to hit upon the elegant direct approach of H. B. Phillips (*Jour. Math. Phys.*, 1922, p. 177) can only be left to him to answer.

There is no doubt Bell's work is readable, interesting and generally good; what it needs is some kind friend who will draw a firm blue pencil through an adjective here, a phrase there and occasionally a paragraph to the end that the work might attain that sort of precision of statement which would be in the true spirit of mathematics and to the further end that Eric Temple Bell, member of the section of mathematics of the National Academy of Sciences, might be protected from some of the cheaper vagaries of John Taine. It would be a mistake to assume that the popularity of the book need suffer thereby.

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SOCIETIES AND MEETINGS

THE ROYAL SOCIETY OF CANADA

THE annual meeting of the Royal Society of Canada took place in Ottawa from May 24 to May 27 under the presidency of Dr. A. G. Huntsman, of Toronto. The presidential address on "The Problem of Life" discussed first the life history of the salmon and went on to consider philosophically the relation between the mind and the physical universe.

Dr. Victor Morin, of Montreal, was elected president for 1938–1939. New fellows in the scientific sections were: Dr. W. H. Barnes, McGill University; Dr. R. E. De Lury, Geological Survey, Ottawa; Dr. F. L. Drayton, Dominion Experimental Farm; Professor J. R. Dymond, University of Toronto; Dr. J. E. Gill, Dr. Duncan Graham, University of Toronto; Dr. J. A. McRae, Dr. V. H. K. Moorhouse, University of Manitoba; Dr. E. H. Moss, University of Alberta; Dr. E. G. D. Murray, McGill University; Dr. S. E. Slipper and Dr. Alice Wilson. The Flavelle Medal for outstanding scientific achievement was awarded to Dr. W. Lash Miller.

In the Section of Chemical, Mathematical and Physical Sciences ninety-nine papers were listed. The presidential address of Dr. R. H. Clark, of the University of British Columbia, was devoted to "Enzyme Activators," and among other papers in the chemical subsection may be noted those of Dr. E. W. Steacie and N. W. F. Phillips "On the Mercury Photosensitized Decomposition of Ethane," of Dr. W. Lash Miller on further studies of Wilder's Bios, and a series of nine papers by Professor O. Maass and associates dealing with viscosity, rates of reaction, specific heat and density of various gases and liquids in the vicinity of the critical temperature and critical pressure. Among the physics papers, Professor J. S. Foster and Dr. A. Vibert Douglas reported on a study of the stark effect of helium lines in B stars, demonstrating that the absorption which occurs between known d and f lines can not be explained on the basis of laboratory experiments, Doppler effect, relative intensity changes in absorption as compared with emission or collisional damping. Professor J. A. Gray showed that Radium E emits no primary γ-rays but 1.5 per cent. of the disintegrating atoms emit a secondary γ-ray of varying intensity. Professor J. Satterly reported further experiments on inclined water jets, definitely disproving Levi-Civita's original theory. Professor E. F. Burton communicated several papers, of which one was devoted to the velocity of sound in liquid helium at ultrasonic frequency at temperatures from 4.2° to 1.7° K, and another (by Messrs. Johns and Wilhelm) to the refractive index of liquid helium. Professor A. L. Clark and L. Katz presented a method of measuring the specific heats of gases by a modified Assmann technique, and Professor J. K. Robertson and R. H. Hay one for removal of wall deposits from tubes carrying high frequency discharges. Dr. E. A. Hodgson described variations in the thickness of the earth's crust deduced from earthquake records, and various papers on applied geophysics were presented by Dr. L. Gilchrist, Dr. D. A. Keys and their associates.

Among the mathematical papers were one by Professor S. Beatty "On the Cycles of an Algebraic Equation $f(x) = 0$ Relative to Infinity" and one by Professor J. L. Synge on "The Stability of Plane Poiseuille Motion." Professor R. L. Jeffrey discussed "Integration in Abstract Space." Professor I. W. Campbell considered the lateral support of towers supported by guy wires, Mr. R. Meldrum Stewart described a new time signal clock in the Dominion Observatory, and Dr. R. E. De Lury discussed observations on the redward shift of spectral lines near the solar limit.

In the section on Geological Sciences, Dr. E. S. Moore gave a presidential address on "Some Problems of the Canadian Shield," discussing the Precambrian granites, life in the Precambrian and other topics. Papers on glaciology were presented by J. T. Wilson, describing an area in Nova Scotia where there are 2,300 drumlins, by G. W. H. Norman and by J. T. Wilson on the last Pleistocene ice front and the moraines, beaches, etc., in certain parts of Quebec. R. L. Rutherford reported studies of glaciation in Alberta, Dr. Alice E. Wilson gave an account of gasteropods collected by the Cambridge-Oxford expedition of 1931 on Akpatok Island, Hudson Strait, and Dr. F. H. McLearn of Triassic faunas of the Peace River foothills. Dr. E. M. Kindle described the Devonian succession at the east end of Gaspé, Dr. J. A. Allan occurrences of Cambrian rocks in Jasper Park, Alberta, and Dr. L. S. Russell the skull of *Hemipsalodon grandis,* a giant Oligocene creodont. Professor L. Gilchrist and Dr. J. S. DeLury discussed exploration of ore bodies. Dr. M. Y. Williams presented a paper on submarine channels and orogenic movements on the British Columbia coast. Dr. L. S. Russell offered views on the origin of sandstone dykes in Alberta. A paper by N. B. Keevil showed that the helium method of age determination indicates the length of geological time to be considerably less than is generally believed.

The presidential address in the Section on Biological Sciences, by Professor V. E. Henderson, of Toronto, reviewed the anesthetic problem and considered the good and bad qualities of some commonly employed anesthetics. Six zoological papers, thirteen botanical and 25 on medical and related sciences were offered. Dr. E. M. Walker showed that the primitive insect, Grylloblatta, is more closely related to the Saltatoria than to other Orthoptera. A paper by Professor C. McLean Fraser was devoted to the distribution of hydroids. Dr. E. Horne Craigie reported on vascularization of the hypophysis in salamanders. Frère Marie-Victorin suggested that earlier views regarding the relic flora of Canada require revision. Dr. A. E. Porsild described the flora of Little Diomede Island,

Bering Strait, and Dr. D. C. McPherson gave an account of the formation of air spaces in the root cortex of maize. Professor R. B. Thomson discussed the phylogeny of the cone structure of the yew, and Professor A. H. Hutchinson and Miss Helen Farley described ovule development in alfalfa hybrids. The malting quality of varieties of barley was considered by Dr. J. A. Anderson, of the National Research Laboratories, while Dr. R. Darnley Gibbs described seasonal changes in the composition of white birch trees. A group of papers from the Banting Institute was devoted to researches relating to silicosis. Dr. D. A. Scott reported the preparation of nickel-insulin crystals. The zinc, like protamine, prolongs the action of insulin. Drs. C. H. Best and D. Y. Solandt have been studying coronary thrombosis, while Dr. P. J. Moloney reported investigations of "The Detoxifying Action of Human Bile," showing that this material renders diphtheria toxin harmless. Drs. W. R. Campbell and M. I. Hanna submitted an account of the proportions of the various proteins in the blood plasma of human beings in health and disease. A benign tumor produced by accidental injection of a plant hormone into the human hand was described by Dr. J. H. W. Willard.

E. HORNE CRAIGIE

UNIVERSITY OF TORONTO

THE VIRGINIA ACADEMY OF SCIENCE

THE Virginia Academy of Science held its sixteenth annual meeting on May 5, 6 and 7 at the Virginia Polytechnic Institute with a registration of more than 400 and a reported membership of 809.

All the factors were present for an enjoyable and successful meeting: perfect weather, a beautiful campus, complete preparations, an interesting program.

About 70 members attended the Academy Conference Thursday night, which is an open forum for the presentation of reports and the discussion of any matters pertaining to the work of the academy. All day Friday and Saturday forenoon were given over to sectional meetings, during which 28 papers were presented in the Section of Astronomy, Mathematics and Physics; 34 in Biology; 45 in Chemistry; 14 in Education; 23 in Geology; 22 in Medical Sciences; and 10 in Psychology—a total of 176.

The guest speaker Friday night was Professor John F. Dashiell, of the University of North Carolina and president of the American Psychological Association, who spoke on "Revisions of Our Conception of Learning Demanded by Recent Experimental Findings."

At this meeting Dr. J. Shelton Horsley, Sr., chairman of the research committee presented the academy prize of $50 to Dr. S. G. Bedell, of the University of Virginia, for a paper entitled "Observations on the Lateral-Line Organs of Living Amphibian Larvae with Special Reference to Orange Colored Granules of the Sensory Cells," and the Jefferson Gold Medal to Mr. H. M. Phillips, of the University of Virginia, for a paper entitled "Karyology and the Phyletic Relationships in the Plumbaginaceae."

The following officers were elected for the year 1938–39: Dean Earle B. Norris, of the Virginia Polytechnic Institute, *President;* Professor Ruskin S. Freer, of Lynchburg College, *President-Elect;* and Major W. Catesby Jones, of the Virginia Department of Agriculture, *member of the council.*

The new officers of sections are as follows:

Astronomy, Mathematics and Physics:
Chairman, Charles H. Wheeler, III, of the University of Richmond.
Secretary, A. N. Vyssotsky, of the University of Virginia.

Biology:
Chairman, G. M. Shear, of the Virginia Polytechnic Institute.
Sub-Chairman, W. E. Bullington, of Randolph-Macon College.
Secretary, Lena Henderson, of Randolph-Macon Woman's College.

Chemistry:
Chairman, W. E. Trout, Jr., of Mary Baldwin College.
Secretary, W. J. Frierson, of Hampden-Sydney College.

Education:
Chairman, C. E. Myers, of the Virginia State Board of Education.
Secretary, J. A. Rorer, of the University of Virginia.

Geology:
Chairman, Ernest W. Sniffen, of Hampton, Va.
Secretary, William M. McGill, of the Virginia Geological Survey.

Medical Sciences:
Chairman, Walter B. Martin, of Norfolk, Va.
Secretary, I. D. Wilson, of the Virginia Polytechnic Institute.

Psychology:
Chairman, R. H. Henneman, of the College of William and Mary.
Secretary, W. M. Hinton, of Washington and Lee University.

At the business meeting the following resolution was unanimously passed by the academy:

Recognizing the very great importance of the proper use of animals in research, in the production and testing of therapeutic agents and in the development of surgical procedures indispensable for human welfare, be it

Resolved, that the Virginia Academy of Science gives its unqualified indorsement to the California Society for Medical Research in its efforts to prevent the passage in California of the so-called "State Humane Pound Law"—a measure whose enactment would cripple seriously scientific research into the causes and cures of disease, and be it

Further Resolved, that the Secretary of the Virginia Academy of Science transmit this action to the California Society for Medical Research.

Following the meeting there were two field trips, one for biology and one for geology. The academy will meet next year in Danville, Virginia, during the first week-end in May.

E. C. L. MILLER,
Secretary

THE TENNESSEE ACADEMY OF SCIENCE

FOR the convenience of members residing far from Nashville one of the meetings of the academy each year is held in East or West Tennessee and in the springtime in order to favor field trips. The spring meeting of 1938 was held on May 6 and 7 in Knoxville. Three fourths of the members attending the meeting were from East Tennessee. The program of papers was limited to Friday, the second day, Saturthe state. In addition to the general sessions on Fripapers were by representatives of thirteen schools of day, being reserved for field trips. Four fifths of the day, there was in the afternoon a symposium on the "Biology of the Great Smoky Mountains National Park" by A. J. Sharp, Stanley A. Cain, H. M. Jennison and A. C. Cole, of the faculty of the University of Tennessee, and Arthur Stupka, Willis King and Charles S. Grossman, of the National Park Service.

The Knoxville Science Club was host at a luncheon during the noon hour at the Andrew Jackson Hotel. Bowen S. Crandall, of the Division of Forest Pathology, United States Department of Agriculture, presided, and Dr. C. D. Sherbakoff, of the Department of Plant Pathology, University of Tennessee Agricultural Experiment Station, spoke on "Genetics." In the evening the academic dinner was held at the Andrew Jackson Hotel. Dr. H. H. Walker, of the Department of Public Health, University of Tennessee, introduced by President Shaver, delivered an illustrated address on "Natural Color Photography."

Three field trips were offered for Saturday: (1) All-day biological field trip to Ramsey Cascade, Greenbrier, Great Smoky Mountains. (2) Half-day field trip to Norris Dam and vicinity. (3) All-day geological field trip.

Trip No. 1 was taken by twenty-two persons under the guidance of Arthur Stupka, park naturalist. The last 2.5 miles was covered by walking through an undisturbed forest of great beauty, in which many trees of great size were observed, notably the tulip poplar and the black cherry. The waterfall is regarded by some as the most spectacular in the Great Smoky Mountain National Park area.

For Trip No. 2, the announcement was made that the activities of the Wild Life Division would be inspected under the leadership of Dr. A. R. Cahn, and the engineering features of the dam would be discussed by N. W. Dougherty. One may surmise that the announcement was intended to dodge questions socialistic, economic, chemical, physiological, political suggested to the curious by the Norris village, stored energy of the dam, the dead fish in the waters of the lake and the minerals underneath.

Trip No. 3 was taken by a group of ten under the leadership of Berlen C. Moneymaker, of the Tennessee Valley Authority. A drive of eighty miles brought them by way of Tellico Plains, noted in the history of the Cherokees, and over the Unaka Mountains to the dam under construction in the Hiwassee River twenty-two miles below Murphy, North Carolina. While the lake formed, having a short line of 150 miles, will not be so large as the Norris reservoir, the dam will have an approximate heighth from the lowest excavation to the roadway across it of about 300 feet, the highest of a dam anywhere, one of the geologists informed me. There remains yet to the Tennessee Valley Authority adjustment with the owners of the value of the original water power, of the many tracts of land that will be overflowed and the unseen but prospective minerals underneath. The Ducktown Basin through which the party next passed was formerly a flourishing forest. Now it is a desert of about twenty square miles, blasted, denuded, corroded by the gases formed in the manufacture of copper, for a number of years allowed to escape into the air. The metamorphic geology along the Ocoee River, the Parksville Dam and the Cartersville fault were objects of interest to the geologists on their way from Ducktown down the Ocoee to Benton and back to Knoxville by Etowah and Athens.

JOHN T. MCGILL,
Secretary

SPECIAL ARTICLES

ANAPHYLAXIS IN THE LIVERLESS DOG, AND OBSERVATIONS ON THE ANTICOAGULANT OF ANAPHYLACTIC SHOCK

THE recognition of the important rôle of the liver in the phenomenon of anaphylaxis in the dog dates from the observations of Manwaring.[1] The most characteristic feature of canine anaphylaxis is the tremendous engorgement of the liver. While some investigators consider the hepatic changes to represent the most

[1] W. H. Manwaring, *Zeits. Immunitätsforsch.*, 8: 1, 1911.

obvious aspect of a generalized reaction involving a number of different tissues, no one has been able to demonstrate, satisfactorily, any of the typical symptoms of anaphylaxis in the dog after exclusion of the liver. Indeed, because of this lack of success and the obvious involvement of the liver in the intact animal, it has been almost universally agreed that anaphylactic shock in the dog is not possible in the absence of the liver. We (E. T. W. and J. M.) have been able to show conclusively that anaphylactic shock can be elicited in sensitized dogs from which the liver has been completely removed.

The dogs used in these experiments were sensitized to horse serum by subcutaneous injection of 5 ccs of serum to which 1 per cent. alum had been added 24 hours earlier. Six weeks were allowed to elapse between the injection of this sensitizing dose and the shock dose of 20 ccs of normal serum. Encouraged by the marked success obtained in sensitizing guinea-pigs to ragweed pollen extracts after the addition of alum,[2] we hoped to induce in dogs by a similar preliminary treatment of antigen a more uniform high degree of sensitization than by methods usually employed. All animals so far sensitized in this manner have shown very pronounced shock.

The liver of one of these dogs was removed in a single operation.[3] Later, when serum was injected into this animal, there was a marked fall in blood pressure (sharply from 108 mms Hg to 50 mms Hg, followed by a further gradual decline) with a concomitant increase in urinary bladder tone. The animal died 55 minutes after removal of the liver and 30 minutes after the shock dose of serum. Nothing was found to indicate that death was not due primarily to anaphylactic shock. As a control an equal amount of the same stock of serum was injected into a normal dog without causing any change in blood pressure or bladder tone.

We (E. T. W. and L. B. J.) have investigated the changes in the coagulability of the blood of dogs during anaphylaxis and also in peptone shock. Use has been made of the recently discovered fact,[4] which has been confirmed in this laboratory, that protamine combines quantitatively with heparin; 1 mgm of protamine inhibits approximately 33 units of heparin. At intervals after the administration of the shock dose, samples of blood have been removed from the exposed femoral vein and titrated at 37° C. with 0.5 ccs of solutions containing amounts of protamine (salmine) varying from 0.001 to 0.1 mgms, the end point of the titration being the smallest amount of protamine which will reduce the coagulation time of 0.5 ccs of the sample to that of blood samples taken prior to shock. The anticoagulant of anaphylaxis or peptone shock was completely inhibited by protamine. Representative results are presented diagrammatically in Fig. 1. The results

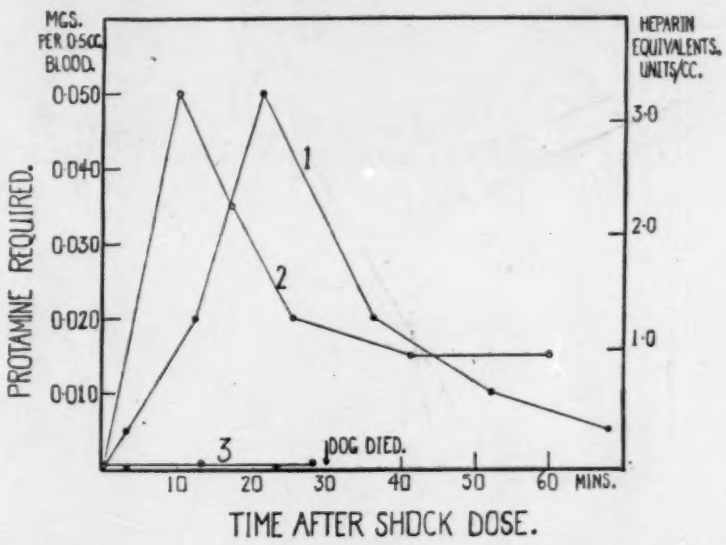

FIG. 1. 1, Anaphylactic shock under ether anesthesia; 2, Peptone shock (0.3 g./kilo.) without anesthesia; 3, Anaphylactic shock of hepatectomized dog under ether anesthesia.

shown in Curves 1 and 2 are in general accord with those of other workers who have estimated the antithrombin titre of the blood of the dog in anaphylaxis[5] and peptone shock.[6] Blood samples of shocked animals, untreated with protamine, remained uncoagulated at 37° C. for more than two days, except those taken from the shocked liverless dog; there was no change in the clotting time of the blood of this animal, (Curve 3). Clearly this result points to the liver as the source of the anticoagulant liberated during shock of the intact dog. It is of interest to note that the heparin titre of the blood of the animal in the experiment illustrated by Curve 1 would account for a liberation of at least one third of the average amount of heparin which can be extracted, by one method,[7] from normal dog liver.

The significance of these findings on present conceptions of anaphylaxis and of the physiological status of heparin will be discussed when they are presented in detail elsewhere.

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[2] A. H. W. Caulfeild, M. H. Brown and E. T. Waters, *Jour. Allergy*, 7: 451, 1936.

[3] J. Markowitz, W. M. Yater and W. H. Burrows, *Jour. Lab. and Clin. Med.*, 18: 1271, 1933.

[4] E. Chargaff and K. B. Olson, *Jour. Biol. Chem.*, 122: 153, 1937.

[5] H. Eagle, C. G. Johnston and I. S. Ravdin, *Bull. Johns Hopkins Hosp.*, 60: 428, 1937.

[6] A. J. Quick, *Am. Jour. Physiol.*, 116: 535, 1936.

[7] A. F. Charles and D. A. Scott, *Jour. Biol. Chem.*, 102: 431, 1933.

SOLUBLE SOLIDS IN CITRUS FRUITS

SUTHERST[1] and Haas and Klotz[2] have shown that a physiological gradient exists in mature citrus fruits. Haas and Klotz found that the osmotic pressure of the juice from the pulp of the stylar-end third of Valencia fruits in late summer was approximately 18.34 atm while that from the stem-end third was only 13.49 atm. In making a study of an abnormal physiological condition in Valencia fruits, many thousands of fruits have been cut and observed. In many instances, and especially during the summer of 1937, after the low temperatures of the preceding winter, fruit segments were found to be frozen at the stylar end and not at the stem end. The high osmotic pressure in the stylar end of the fruits would naturally indicate that any freeze injury which might occur should be found in the stem end rather than in the stylar end of the fruit.

Between January 5 and March 21 the soluble solids content of the juice in the stem and stylar halves of each locular segment in 50 Valencia and 15 navel oranges and in 9 grapefruits was determined separately—1,542 determinations. The determinations were made with an Abbé refractometer.

Of the 268 segments from Valencia fruits picked between January 5 and February 16, twenty-two per cent. had a lower soluble solids content in the stylar end than in the stem-end half. The remainder of the tests on Valencia segments (248) were made between March 11 and March 21 when the fruits had become more mature. During this period only one segment was found that had a lower soluble-solids content in the stylar than in the stem half.

Most of the low temperatures in California come in the months of December and January. The results just mentioned explain why freeze injury may occur in the stylar end of a Valencia segment and not in the stem end. They indicate that the soluble solids polarity, so far as the stem and stylar ends of the Valencia fruit are concerned, does not become noticeably evident until the fruit has nearly or actually reached maturity.

In making a study of the results of the soluble-solids tests, another interesting and unexpected evidence of polarity in citrus fruits was discovered. Thirty-nine of the 44 Valencia fruits picked from the twigs on the *outside* of the trees had a higher soluble-solids content in the three north segments than in the three south segments of the same fruit. This condition prevailed in the stem half as well as in the stylar half of the segments and was equally true for fruits borne on the north, east, south or west side of the trees. The differences were not great but apparently significant. The amounts of soluble solids in the fruit having the greatest difference were 12.17 per cent. in the three south segments and 13.27 per cent. in the three north segments. Similar figures for the one showing the least difference were 11.56 per cent. and 11.62 per cent., respectively. These figures represent an actual difference in amount of materials of 8 per cent. in the former and 1 per cent. in the latter, or an average of 3.4 per cent. One of the 44 fruits had equal amounts of soluble solids in the three north and in the three south segments, while in four of them the soluble-solids content of the three south segments was slightly greater than that of the three north segments. The results of tests on other Valencia fruits, based on dry weight rather than on per cent. of soluble solids, gave results similar to those already recorded in this paragraph, except that the differences were slightly higher.

The remaining six of the 50 Valencia fruits tested for soluble solids were taken from the *inside* of the trees, near the trunk. The soluble-solids content of four of these was greatest for the three south segments and only two had the highest content in the three north segments. It was of interest to find that there was a difference, one way or the other, in all but one of the 50 Valencia fruits tested.

The navel oranges and grapefruits, picked between January 10 and February 28, showed a north-south polarity of soluble solids similar to that in the Valencias. The average difference was more pronounced in the navel (6 per cent.) than in either the Valencia (3.4 per cent.), or the grapefruit (4 per cent.).

A more complete report of these and further results will be published elsewhere in the near future.

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[1] Sutherst, *California Cultivator*, 36: 612, 1911.
[2] Haas and Klotz, *Hilgardia*, 9: 181–217, 1935.

A RELATION BETWEEN THE ELECTRONIC RADIUS AND THE COMPTON WAVE-LENGTH OF THE PROTON

THE classical radius of the electron ($a = e^2/(mc^2)$) and the Compton wave-length of the proton ($b = h/(m_p c)$) seem to be in the simple ratio of 3 to $\sqrt{2}$. We have by definition

$$\frac{a}{b} = \frac{m_p/m}{2\pi\alpha}$$

where $\alpha (= (hc)/(2\pi e^2))$ is the reciprocal of Sommerfeld's fine-structure constant. If, in accordance with Birge,[1] we insert the values $m_p/m = 1835$, and $\alpha = 137.06$, we find as an empirical value $a/b = 2.13$, whereas $3/\sqrt{2}$ is 2.1213. The divergence seems to be within the limits of observational error.

[1] R. T. Birge, *Phys. Rev.*, 49: 203, 1936.

The relation $a/b = 3/\sqrt{2}$ may perhaps be derived by starting with a result of Sitte and Glaser. These authors[2] derived the following relation:

$$h/(Z\, m_p c) = R/(Z'\, \sqrt{Z})$$

where Z' is the total number of particles in the universe, Z the total number of "heavy" particles (whose mass is large in comparison with the mass of the electron), and R the equilibrium radius of the universe. If we distinguish between protons and neutrons (a distinction not made by Sitte and Glaser), we must put

$$Z' = 2\,P + N,\ Z = P + N$$

where P is the total number of protons or electrons, and N the total number of neutrons, respectively.

We thus find

$$\frac{h}{(P+N)\, m_p c} = \frac{R}{(2P+N)\, \sqrt{P+N}}$$

or

$$b = R\, \sqrt{P+N}/(2P+N).$$

Now, according to Eddington[3] and the author[4]

$$R^2 = P\, a^2,$$

or the surface of a sphere which would include the total equilibrium volume of the universe, is equal to the sum of the spheres of action of all electrons. Hence

$$a/b = (2P+N)\,/\,\sqrt{(P+N)P}.$$

If we make the very simple assumption that in the state of equilibrium the number of protons equals the number of neutrons, we thus actually find

$$a/b = 3/\sqrt{2}.$$

The occurrence of the integers three and two in this formula finds its explanation in the fact that we distinguish three essential types of primordial particles, two of which are "heavy."

Conversely, we may conclude from the observational value of the ratio between the electronic radius and the Compton wave-length of the proton that in the equilibrium state of the universe one third of its primordial particles are protons, one third electrons and one third neutrons.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A GROWING YEAST MEDIUM FOR THE CULTIVATION OF AN HEMOPHILIC BACILLI AND OF AN ORGANISM CAUSING A BRONCHITIS IN CHICKENS[1]

THE writers obtained much better growth of *Hemophilus gallinarum* and *Hemophilus influenzae*[2] when cultivated with growing yeast[3] than could be obtained with the use of a chicken blood medium.

The growing yeast supplies all the growth requirements for both organisms, and they have been successfully cultivated for several months in such a blood-free medium (by weekly transfers).

The yeast and the hemophilic bacilli were cultivated on a medium of the following composition: Difco dehydrated nutrient agar, 23 grams; Difco phenol red maltose, 10 grams; salt, 8 grams; added to 1,000 cc of the broth in which 400 grams of raw potato had been cooked. The sterilized tubed medium was used in the form of slants, at the base of which a small amount of sodium chloride solution was used to prevent drying of the surface. The growing yeast on this medium results in a change of the pH from acid to alkaline in reaction within 24 hours at 37° C. incubation. The change in pH is possibly responsible for the success of the medium. Difco phenol red dextrose and sucrose have been substituted and used instead of the maltose, with similar results. A medium prepared by using plain agar, Bacto beef extract, maltose, phenol red and salt, in the same proportions as the medium already described, would indicate the change from acid to alkaline results from the reaction of the yeast on the beef extract, because, when Bacto peptone is substituted for the beef extract, the medium remains acid.

Since the growing yeast fulfilled the growth requirements of the hemophilic organisms better than blood, the question arose as to whether it would be of value in studying other respiratory diseases of poultry.

An infectious bronchitis of chickens of a clinically similar type[4] as that which our studies had indicated was of a filterable virus nature was studied in this respect.

Cultures were carefully obtained from the edematous fluids of the lungs of infected birds and used along with pure cultures of yeast to inoculate the medium. Previous investigations had indicated that the lungs were frequently free of bacteria as found by the use of chicken blood media.

Growth other than yeast was obtained from one chicken out of five in this manner. Stained preparations indicated two different types of organisms in

[2] K. Sitte and W. Glaser, *Zeitschr. f. Physik*, 88: 103, 1934.

[3] A. S. Eddington, *Proc. Roy. Soc. London* (A), 133: 605, 1931.

[1] Published by permission of the Director of Research as Contribution No. 527 of the Rhode Island Agricultural Experiment Station.

[2] Cultures obtained through the courtesy of Dr. John H. Dingle, Harvard Medical School.

[3] Pure yeast obtained from Fleischmann's Stock and Poultry Yeast.

[4] A. Haas, *Anz. Akad. Wiss. Vienna*, 67: 161, 1930 and 69: 91, 1932.

[4] J. P. Delaplane, L. E. Erwin and H. O. Stuart, *Jour. Agr. Res.*, 52: 5, 382, 1936.

addition to the yeast. The first seven transfers of this culture induced symptoms of bronchitis in chickens when inoculated intra-tracheally. One type of organism overgrew the other, and it was no longer infective after the seventh transfer. The cultures in which no growth but yeast occurred failed to induce the infection in chickens, indicating the causative agent had grown in the one in which other organisms had been noted.

A culture obtained from the trachea near its bifurcation with the lungs was found to show, upon microscopic examination of stained smears of what appeared as pure yeast colonies, a moderate growth of an apparently pure culture of an organism which had been one of the types present in the first successful cultures. Chicken blood at the base of nutrient agar slants, inoculated with the same material, remained sterile.

The organisms in question are comparatively large, very irregular in shape, appear singly, double or in clumps, and are decolonized with Gram's stain after 24 hours' incubation. The shape may vary from irregular circular to pear or rod shapes.

The typical symptoms of the bronchitis have been successfully reproduced during twelve transfers of the cultures over a three-week period from the time they were first isolated. The same organisms have been successfully reisolated from the infected chickens, and in turn found to be capable of inciting the disease.

The organisms have repeatedly failed to grow in or on chicken blood and other types of media, so that further studies will be required before any identification is possible.

The use of such a medium has resulted in the isolation of an organism which may have otherwise escaped detection.

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H. O. STUART

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PRESERVATION OF ANATOMICAL SPECIMENS

A SIMPLE method to preserve anatomical specimens for museum and teaching purposes may be utilized by applying the following solution; one part of formalin, three parts of 95 per cent. alcohol and two parts of ordinary white shellac. The cadavers from which the specimen is obtained have been preserved for varying periods of time from several months to a year or longer, with equal parts of 95 per cent. alcohol, phenol and glycerin, to which a small quantity of formalin has been added, approximately one pint to five gallons of the above solution.

Groups of muscles, leaving the origin and insertion upon the bones with nerves and blood vessels if desired, hearts and other organs have now been kept in this laboratory for the past five years with this method.

After dissection, if necessary, the material is allowed to dry from 8 to 24 hours and then with a sprayer two or three applications of the solution are used, allowing each to dry before another coating is given. Respraying the specimens every year or two helps to keep them in good condition.

JOHN R. PATE

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SCHOOL OF MEDICINE

CELLOPHANE USED FOR PROJECTION DRAWINGS

IN studying the vascular pattern of the thymus, a quick, inexpensive method for showing the relationships of vessels was found by projecting the sections on sheet Cellophane such as is used for wrapping parcels, etc. Different parts were represented by colored ink, and mistakes were easily rectified by washing them out. Composite line-drawings were made from a number of single sheets and these in turn put together, until the completed drawing was made. The Cellophane wrinkles somewhat when removed from the roll, but this has not been found to be a hindrance as the pieces were kept flattened out on cardboard by thumb tacks. This method has proved very useful when time and expense were limited.

CHRISTIANNA SMITH

MOUNT HOLYOKE COLLEGE

BOOKS RECEIVED

BERLAND, LUCIEN. *Les Araignées.* Les Livres de Nature, 43. Pp. xii + 173. Delamain et Boutelleau, Paris. 15 fr.

COATES, ADRIAN. *A Basis of Opinion.* (Philosophy.) Pp. xvii + 461. Macmillan. $4.50.

DANIELS, FARRINGTON. *Chemical Kinetics.* Pp. viii + 273. 41 figures. Cornell University Press. $3.25.

ELLIS, CARLETON and MILLER W. SWANEY. *Soilless Growth of Plants; Use of Nutrient Solutions, Water, Sand, Cinder, etc.* Pp. 155. 58 figures. Reinhold. $2.75.

KENDALL, JAMES. *Breathe Freely! The Truth About Poison Gas.* Pp. xi + 179. Appleton-Century. $1.50.

Life of Chevalier Jackson; An Autobiography. Pp. x + 229. Illustrated. Macmillan. $3.50.

MOORE, CHARLES N. *Summable Series and Convergence Factors.* Pp. vi + 105. American Mathematical Society, New York. $2.00.

MUNN, NORMAN L. *A Laboratory Manual in General Experimental Psychology.* Revised edition. Pp. viii + 285. 21 figures. Prentice-Hall. $1.90.

PORTEVIN, G. *Ce Qu'il Faut Savoir des Insectes.* Pp. 188. 8 figures. 20 plates. Lechevalier, Paris.

RAUP, HUGH M. *Botanical Studies in the Black Rock Forest.* Bulletin No. 7, 1938. Pp. vi + 161. Illustrated. Henry H. Tryon, Director, Cornwall-on-the-Hudson, New York. $1.50.

RITZMAN, ERNEST G. and FRANCIS G. BENEDICT. *Nutritional Physiology of the Adult Ruminant.* Pp. vi + 200. 3 figures. 3 plates. Carnegie Institution.

SIVADJIAN, M. JOSEPH. *La Chimie des Vitamines et des Hormones.* Les Monographies de Chime Pure et Appliquée (Nouvelle Série). Pp. 239. Gauthier-Villars, Paris. 50 fr.

SCIENCE NEWS

Science Service, Washington, D. C.

ACCURACY AND ASTRONOMY

ASTRONOMY, pictured generally as that science which almost believes in accuracy for accuracy's sake, has now been painted as one more science in which minute exactness is not always the most necessary thing. Astronomy has made giant strides on the basis of approximations and many relatively crude observations by ancient star-gazers are still useful, according to Dr. Henry Norris Russell, retiring president of the American Astronomical Association, in his presidential address delivered at the meeting of the association in Bloomington, Ind. Dr. Russell, who is research professor of astronomy at Princeton University, pointed out that in certain cases, wholesale observations whose accuracy is such that many an astronomer would call them crude are nearly as valuable as much more precise measurements. The stellar magnitudes of Hipparchus still provide our best observational evidence that the stars by and large do not change their brightness perceptibly in a mere couple of millennia. The old estimates, though of low precision, nevertheless gave us real scientific information.

Professor Russell discussed the problem of accuracy from the astronomer's point of view, indicating also that another important factor entering into the question is the extent to which the director of an observatory with limited means wishes to spend money and energy in securing more and more accurate observations. He indicated that spending effort and funds for accuracy is justified to the extent that the problem under study requires accurate measurements for its solution.

THE PROTEIN BASIS OF LIVING MATTER

DR. MAX BERGMANN, of the Rockefeller Institute for Medical Research, New York City, reported at the Richmond meeting of the American Chemical Society that the chemical bonding of vital protein, basis of all living matter, is bound up with the number 288. Not only is 288 a number intimately connected with life itself in the higher animals, but it is a number closely related with heredity and the ability of parents to transmit physical characteristics to their offspring.

It was formerly though, said Dr. Bergmann, that an almost infinite variety of proteins could exist. Dr. Emil Fischer had advanced such a theory whose implications pictured a protein for the hair of man, a different one for the hair of a dog, another for sheep hair and so on for each species of animal. And then the whole process was repeated for proteins in any other part of the body, again throughout the whole animal and plant kingdoms. By varying the combinations of only 30 amino acids, for example, it was possible to postulate the existence of 1,280,000,000,000,000,000,000,000,000 different proteins.

Analysis in Dr. Bergmann's laboratory, however, has brought new order out of this apparently jumbled picture. The only protein combinations permitted to exist in nature consists of those containing 288 amino units, or some simple whole number multiple of 288. Out of his work Dr. Bergmann has been able to fashion what might be called a mathematical rule for life. Says Dr. Bergmann: "Proteins appear to contain $2^m \times 3^n$ units per molecule, where m and n are whole positive numbers."

The first step in the new knowledge was the creation of relatively simple peptide-like substances serving as simple protein models with which could be studied the action of the various enzymes. It was by the study of these synthetic protein models that the amazing regularity of 288 and multiples of 288 appeared. Gradually it became apparent that enzymes had specific duties to perform and that, in fact, each kind of protein is created by the action of its specific enzyme. This fact, said Dr. Bergmann, is a new understanding of body chemistry, for it had previously been supposed that the action of the enzymes was to break down complex proteins into those the body could use. Now enzymes take on the new rôle of permitting, indeed determining, the building up of body proteins.

The mechanism of creating the complex proteins now appears to be a sequence of many reactions wherein a simple protein is turned, by its specific enzyme, into a more complex protein. This protein, in turn, has a specific enzyme that builds it into a still more complex protein, and so on. The whole chain of reactions therefore goes on until finally a protein is created which does not have present the specific enzyme that can build it higher, and there the chain stops.

"Thus the specificity of an individual enzyme predetermines the molecular pattern of the protein synthesized by this enzyme. The numerical rules governing a protein molecule have their basis in the specificity of the enzyme involved," according to Dr. Bergmann. "Here we arrive, for the first time, at a physico-chemical concept of the predetermination which is an inherent attribute of many phenomena of life. The question has frequently been discussed whether hereditary phenomena are connected with, and explained by, a transmission of individual proteins and, in particular, whether the chromosomes are proteins. On the basis of the conclusion which we have reached I think you will agree that the essential substances transmitted from one generation of cells to the next, from parents to children, must be enzymes and that they have to be enzymes with the capability of synthesizing individual proteins by predetermined sequences of specific reactions."—ROBERT D. POTTER.

MICROCHEMISTRY

THE newest tools of chemistry were displayed at the meeting of the American Chemical Society in Richmond. No contrast between the old and the new in chemistry is quite so marked as that between the old apparatus and the equipment used in the science of microchemistry which finds, in a single drop of material, a whole world of exploration. And nowhere in chemistry is the significance of the difference between the old and the new way of studying nature's secrets so clear. The equipment makes

it possible for chemists to save 99 per cent. of the material they formerly needed in making an analysis. And even more important, the apparatus saves 50 per cent. of the chemist's time.

These tools of modern chemistry are triumphs of the glass blower's art. And in addition to their almost toy-like appearance they never fail to excite the admiration of those who use them. If they drop they are more apt to bounce than break. While glass, in larger units, can rightly be considered a fragile material it is also a material which has considerable strength. Some of the beakers are so small that they rebound, without breaking, like a glass marble which a small boy drops and bounces on the sidewalk.

What advantage does chemistry find in this new apparatus? (1) A vast saving in materials used, and time consumed in an analysis. For common materials the saving is not so important, but there is a whole host of extremely rare materials in the chemical world which have been studied only enough to know that they exist. By research with micro-apparatus new and unknown uses of these materials may be developed. If applications come then chemistry is confident it can find ways of producing these "rare" materials on a large-scale, commercial basis. That has been the past history of this science. But first the chemists must know the possibilities of the material with which they are working. (2) Better and more rapid analysis in chemistry applied to medicine. Again the ability to use small samples is a step toward the saving of lives. Micro-methods in chemistry, in fact, owe much of their pioneer development to the medical chemists. (3) Better chemistry training. The use of small samples permits even the poorer schools to supply their chemistry students with rare and interesting materials with which to work. Moreover, the tiny equipment looks so delicate that students handle it with greater care and, hence, do better work. Finally if reactions go wrong and explosions occur they are only small affairs that do no great damage.

"Microchemistry has ceased to be the tool belonging only to the highly-trained specialist," said Professor A. H. Corwin, of the Johns Hopkins University, who arranged the symposium on microchemistry at the meeting. "It is now available even to freshmen in the 'greencap' stage." Professor Corwin was referring to the trial courses being offered at Hopkins and a few other universities on the technique of teaching chemistry by micro-methods.—ROBERT D. POTTER.

WINTER TEMPERATURES AND THE BLOSSOMING OF PLANTS

PROFESSOR HERMAN KURZ, of the Florida State College for Women, has demonstrated, in experiments with 20 kinds of northern wildflowers, that their rootstocks or other underground parts must be held at a temperature near or below freezing for several weeks if normal growth and flowering is to take place in the spring. His report will be published in the *Proceedings* of the Florida Academy of Sciences.

Professor Kurz tried growing northern wildflowers in his garden. The ones he had sent him, left out through the mild winter of northern Florida, didn't do at all well. Professor Kurz knew, of course, the traditional belief of gardeners that certain plants had to be nearly frozen every winter to make them grow well. He knew also of earlier experiments showing the beneficial effects of chilling on woody plants and on seeds, especially the research of the late Dr. F. V. Coville.

He therefore decided to make tests with non-woody plants. He obtained 20 different kinds of wildflowers from the north. He set rootstocks or bulbs of each kind in twin pots. One pot of each pair he left outdoors, the other pot he put into near-freezing temperature in a cold storage plant.

In the spring he set the pairs of pots together again. The great majority of his species showed good growth and early flowering in the pots that had been chilled, little or no growth and late or no flowering in the unchilled pots. A few species of plants, that grow in Florida as well as in the north, showed no clean-cut differences between chilling and non-chilling.

One group of four species, May apple, bloodroot, wild phlox and Turk's-cap lily, showed very peculiar behavior. Plants that came from New England had to be chilled. Plants of the identical species that grow in Florida would grow without being chilled.

Professor Kurz makes the suggestion that by long custom the northern forms have come to require freezing and by the same token the southern forms have developed an indifference to or no requirement for freezing. Such forms may be termed physiological or ecological species, he says.

Professor Kurz points out, in conclusion, that just as there are many southern flowers and other plants that find northern winters too severe, so also there appear to be numerous wildflowers of the north that can not establish themselves in the south because the winters there are not severe enough to stimulate them to normal growth and reproduction.—FRANK THONE.

INFANTILE PARALYSIS

LOSS of the sense of smell after the nose has been sprayed with zinc sulfate is a sign that the spraying has been done thoroughly enough to protect the child or adult against infantile paralysis, Dr. E. W. Schultz, of Stanford University pointed out at the Washington meeting of the Society of American Bacteriologists. Dr. Schultz is the leader of one of the research groups that have found zinc sulfate nasal sprays effective in protecting monkeys against infantile paralysis. The same material has been sprayed into the noses of many children and young adults during recent epidemics. The results of this spraying were disappointing. Dr. Schultz believes that the reason for the failure of the spray to give children as much protection as it does monkeys is because the spraying was not done thoroughly enough. The virus which causes infantile paralysis gets into the body through the tiny hair-like endings of the nerve of smell. When these nerve endings are destroyed by chemicals, the virus apparently can not get through. Destruction of the nerve endings can be detected by testing the sense of smell. When it is lost

Dr. Schultz believes it is a sign that the child is protected against this disease. The loss is only temporary, as the nerve endings regenerate. In children the loss of sense of smell following chemical spraying may only last 3 or 4 days, and in adults it may be lost for a few months. When the sense of smell returns, it is time to spray again, if infantile paralysis is still prevalent in the neighborhood. Vaccination will not protect against infantile paralysis, Dr. Schultz reported, because vaccination is only effective against germs that get into the blood. The infantile paralysis virus which travels nerve routes rather than the blood route must be fought by chemicals that will strengthen nerve resistance. So far, no way of doing this other than by chemical blockade of the nerve endings with a spray is known.

Those attending the meetings of the Society of American Bacteriologists selected the most needed researches for fighting infantile paralysis. It is believed these studies will receive financial support from the new National Foundation for Infantile Paralysis, although official announcement to this effect has not yet been made. One item on the program will be use of zinc sulfate nasal spray on tens of thousands of children under careful supervision to learn its value in protecting against the crippling childhood malady. A second item is renewed search for possible vaccines or serums for preventing the disease. A third item is investigation of lack of vitamin C as a contributing cause of the disease and the possibility of preventing or treating the disease with vitamin C, the scurvy-preventing vitamin of citrus fruits. The fourth needed study is to determine whether more than one strain of infantile paralysis-causing virus exists and if so, whether an attack of the disease caused by one virus strain will confer immunity to any of the other strains of the viruses.

THE BUREAU OF CHEMISTRY AND SOILS

RESEARCH in a wide variety of fields seeking to find wider industrial uses for farm products are listed in the annual report of Dr. Henry G. Knight, chief of the Bureau of Chemistry and Soils, of the U. S. Department of Agriculture.

During the past year, Dr. Knight reported, 420,000 pounds of sweet potato starch were produced commercially at a plant at Laurel, Miss., by a process worked out by the bureau. Use of the new process will result in substantial savings in the 300,000,000 pounds of starch now imported each year.

New methods of sorgo and sugarcane sirup making were also worked out. A technical bulletin published during the year reported that waste hemlock bark was a source of tannin, used in treating leather. Studies proved that sodium chlorate, chemical weed-killer now sold to farmers at 9 cents a pound in small lots or 6.25 cents a pound in carload lots can be produced at slightly less than 5 cents a pound. This figure, however, although it makes allowance for a five per cent. return on the investment, does not include promotional and distribution expenses.

Another achievement during the past year is a method for determining amino acids in food without first isolating the proteins. Previously proteins had to be isolated before the amino acid content could be determined, but that made difficult determination of the amount of amino acid in the food as a whole. The problem is important both to human and animal nutrition. Experiments in a number of other fields were also successfully carried out.

ITEMS

THE sloth is almost a cold-blooded animal, like reptiles, Professor Sydney W. Britton, of the Medical School of the University of Virginia, has discovered. Dr. Britton made extensive investigations of the physiology of the sloth both on Barro Colorado Island in Panama and in his laboratory. The sloth, he has found, has only about half as much muscle tissue as other animals of the same size and weight. It does not show the changes in body temperature common to other animals. Injections of hormones will jolt it out of its lethargy and speed up its activity considerably. Dr. Britton is now preparing for another trip to Panama to continue his studies, under a fellowship grant from the Guggenheim Foundation.

ALASKA'S new platinum mines, at Goodnews Bay, not far from the Arctic Circle, will produce more than 5,000 ounces of the white metal this year, according to information brought back by Dr. J. B. Mertie, Jr., of the U. S. Geological Survey. Discovered in 1926 by Charles Thorsen, "sourdough" prospector, the platinum deposits resemble geologically the famous placers of the Ural Mountains of Russia, producers of the world's supply of platinum for many years. Worked by crude methods last year, the mines produced 5,000 ounces of platinum metals. This year, in mid-November, a Diesel-powered dredge was put into operation, using fuel oil that costs, at the mines, 19 cents a gallon. Next year, if the ponds don't freeze too soon, the dredge will scrape up almost 20,000 ounces of platinum metals from the bed of Platinum Creek. Like the Russian deposits, the source rock contains too little platinum to be profitably worked, but the stream beds, which have been collecting the platinum freed from the source rock by millions of years of erosion, can be dredged for platinum profitably.

EIGHT dummy tubes in a 14-tube radio receiver make it look big, but they do not improve its operation, Dr. Orestes H. Caldwell, former radio commissioner, reports in *Radio To-day*. Purchasing one of these 14-tube receivers, which resembles a popular make of radio, Dr. Caldwell's staff analyzed it, and found its performance to be about one eighth as good as a legitimate 14-tube set, and not quite as good as that of a standard five-tube receiver. Eight of the tubes, each consisting of a filament in a glass bulb, were connected in series across the line, serving no good purpose in the receiver and wasting power. Lamp bulbs would be just as useful in the same locations. The popular belief that the number of tubes in a radio receiver is a measure of the radio's performance is responsible for the success of this fraud, which can only be guarded against by purchasing standard types of equipment from reputable dealers.

SCIENCE NEWS

Science Service, Washington, D. C.

THE MASS OF THE X PARTICLE

DR. SETH H. NEDDERMEYER, of the California Institute of Technology, in an article published by the *Physical Review*, states that the mass of the new-found "X" particle which scientific investigators have been discovering in cosmic ray research may not have a fixed value.

Dr. Neddermeyer is a colleague of Dr. Carl Anderson and worked with him when the latter made the discovery of the positron for which he received the Nobel Prize award. Anderson and Neddermeyer made the initial discoveries of the "X" particle, whose mass appears to be intermediate between that of the electron and the proton.

Dr. Neddermeyer writes that "There are . . . reasons for believing that the mass (of the X particle) may not be unique and that many masses, ranging from a few times the electron mass up to very large values, may exist." By theory, photons of radiant energy create pairs of particles—positive and negative in electrical sign—in their rush through the atmosphere on their way to earth. The energy and mass possessed by these new particles, that are the offspring of dying photons, are variable. Thus many different masses might be observed, depending on the energy possessed by the original photon that creates them. The point is that particles can have two kinds of mass; the so-called rest mass and a mass due to motion. Theoretically, at least, a particle moving with the speed of light should have an infinitely large mass. The second kind of mass, which varies with the speed of the particle, was observed in the present experiments.

A NEW MICROSCOPE

THERE has been constructed at Harvard University a microscope more than four times as powerful as any microscope ever built before.

Designed by two Harvard geologists, Drs. E. C. Dane, Jr., and L. C. Graton, the new instrument can magnify up to 50,000 diameters, enough to blow the period at the end of this sentence up to the size of a two-story house. Its effective magnification—the limit at which no new details are shown—is 6,000 diameters, more than four times the previous limit. So powerful is it in comparison to its smaller contemporaries that it far surpasses what was believed a year ago to be the theoretical limit of the usefulness of a microscope.

Much of this magnification is "empty," resembling that of a large photographic print produced from a miniature negative. Effective magnification, producing more visible detail as it increases, up to 6,000 diameters is secured with this instrument. Weighing about a ton, the microscope is mounted on the steel bed of a lathe, to secure stability. So fine are the focussing screws that it would take 25 minutes of rapidly turning them by hand to produce a motion of 1/400 of an inch. Motors, with several speeds, do the turning more quickly.

Used chiefly for examining ores, this microscope catches images too small to be detected by ordinary instruments. Objects only a hundred times as large as an atom can be seen and photographed. With the theoretical limits already passed, there seems to be no reason why even greater magnifications, with lenses designed according to revised theories, can not be made. Already, another of these microscopes, patterned after the original model, but slightly improved, has been installed by the Canadian Department of Mines, in Ottawa, to be used in the minute study of ores.

EPIDEMIC DIARRHEA OF THE NEW-BORN

DRS. SAMUEL FRANT and Harold Abramson, of the New York City Health Department, report, in the forthcoming issue of the *American Journal of Public Health*, that the mysterious diarrheal malady that has afflicted infants in Chicago hospitals is not limited to that city. Epidemics of the same sort and probably of the same disease have occurred in many cities in this country and abroad.

The malady has been responsible for a steady increase in mortality among new-born babies in recent years, found chiefly among infants one month old or less. The malady is epidemic diarrhea of the new-born. It is not related to the summer diarrhea which took toll of babies a generation ago. The new malady afflicts infants born in hospitals and strikes during the first three or four weeks of life. No cause has yet been found for the disease. It has been reported in Seattle, Toronto, Memphis, New York, Chicago, Rochester, N. Y., Buffalo, Teaneck, N. J., Cincinnati, Cleveland, Edinburgh, Scotland and Garches, France. In New York there have been 23 such outbreaks in the past three years, affecting 711 infants, of whom 335 died.

The only known way of fighting the disease at present is to break the chain of infection in hospital nurseries from one infant to another. Usual methods of safeguarding infants in hospital nurseries have apparently not been sufficient to prevent the spread of this disease once it starts, and consequently Drs. Frant and Abramson recommend certain new methods to doctors and hospital authorities.

SOYBEAN PLASTIC

SOYBEAN protein plastic is understood to be used in the manufacture of the steering wheel, horn button and other such parts of Ford cars. It is first cousin to casein plastics, made from the jelly-like or cheese curds of milk, which have wide commercial use in buttons, buckles, radio and electrical parts, etc. The soybean is four tenths protein compared with two tenths oil. The protein portion can be mixed with water, various chemicals, colors and filler material, such as wheat chaff, wood flour, etc., to make a useful member of the great group of materials called "plastics." Heat and pressure are used to temper the plastic after it is put into the desired shape.

In addition to development undertaken by Ford and other manufacturers, the Federal Government, through the Bureau of Chemistry and Soils of the Department of Agriculture, established early last year a soybean industrial research laboratory at Urbana, Ill., in cooperation

with twelve North Central states. Here some 30 chemists and other staff members are developing and improving industrial uses of soybeans. The Farm Chemurgic Council has been urging the industrial and other use of soybeans for several years as a part of its program to obtain the use of more American-grown agricultural products in industry.

Although the soybean was introduced in the United States as early as 1804, it is still one of the young giants in our industrial and agricultural life. In the Orient its uses have been many from time immemorial. In recent years the amount of soybean planted has increased greatly. Acreage in 1907 was only 50,000; in 1937 it was 6,049,000 according to preliminary figures. The 1937 crop was between 36,000,000 and 40,000,000 bushels of the bean itself. It is estimated that some 50 factories are turning out various industrial soybean products. Soybeans are used in making such articles as paint, enamel, varnish, glue, printing ink, rubber substitutes, linoleum, insecticides, glycerin, flour, soy sauce, breakfast food, candies, roasted beans with nutlike flavor, livestock feeds, as well as plastics.

AN INSECT ENEMY OF THE SUGAR CANE BORER

THE new insect ally of sugar cane planters was discovered quite by accident. A scientific exploring party was sent out by the Hawaiian Sugar Planters' Association, under the leadership of Cyril E. Pemberton, to seek new types of wild cane. Their boat was ship-wrecked on the New Guinea coast.

Thrown on to a forbidding and possibly hostile shore, the party occupied itself with forays into the jungles while they waited for help. They discovered a patch of cane, close to a swamp. Some of the stalks were afflicted with borers. They opened these up—and found the long-sought enemy of the pest. Marking the place of discovery, and trusting the insect's descendants would still be there when they returned, Mr. Pemberton and his party journeyed on to Honolulu. Elaborate preparations are being made for the insect's importation. With acclimatizing stations established possibly in Samoa, Fiji and New Caledonia, the attempt will be made to transplant it to Hawaii.

Life spans of such insect allies, and the tremendous distances over which they must frequently be brought, make it impossible to carry individual insects through. The originals are generally established near their homeland, where they can be watched and their food requirements studied. Insects on which they feed must be similarly treated. In some cases a whole coterie of enemies of various types must be captured, studied and carefully reared to get a single one through, and a failure in preserving any one type may destroy the chances for the entire expedition. Similarity of climates must also be taken into consideration. Too great a change in one step may spell disaster. It is nothing unusual for a year or more to be spent in carrying a single desired insect over a few thousand miles.

Successfully transplanted, there is still the very definite danger that in the insect's new homeland his life characteristics may suddenly change. An originally valuable species, after acclimatization, may lose its interests in hereditary enemies and be utterly valueless. Even more serious, it may suddenly be imbued with the inclination to cooperate with established pests, and itself become a menace that forces instant eradication.

New insects, life forms, plant species, etc., must therefore be placed in isolation where they can be watched under territorial conditions. Imprisoned in limited areas insects and plants are placed with them, and more months allowed to pass while constant check is kept of developing tendencies. Only after positive proof of benefit are the doors opened and the new ally installed in the field.

ALCOHOL FROM THE JERUSALEM ARTICHOKE

PROFESSOR ELLIS I. FULMER, W. K. McPherson and L. A. Underkofler, of the Iowa State College, reported in *Industrial and Engineering Chemistry* that high yields of alcohol, a fuel already widely used and expected to be even more widely used in the future, can be readily secured from the Jerusalem artichoke, a tuberous plant related to the sunflower. Jerusalem artichokes grown on a single acre of ground will produce more alcohol than two or more acres of corn. Alcohol can be obtained from the plant's tubers by extraction of the carbohydrates and evaporation to a thick syrup and subsequent inoculation with alcohol-producing yeasts.

In test runs between 22 and 26 gallons of 95 per cent. alcohol per ton of fresh tubers have been obtained. In one series of experiments 28.4 gallons of 95 per cent. alcohol per ton was secured. The theoretical yield is about 29 gallons per ton, but it is expected that the maximum yield will be in the neighborhood of 90 per cent. of this figure.

The yeasts used for fermenting the carbohydrates give better results after living on the Jerusalem artichoke culture for a number of generations. The Jerusalem artichoke, which is native to the United States, was used as a food in Europe prior to general use of the potato. As it is not very palatable, since that time it has passed out of general use with the exception of a brief period during the World War when it was revived somewhat because of its high productivity.

A plant for the production of power alcohol from farm crops has been in operation at Atchison, Kans., for more than a year. Experiments with a number of crops have been tried, with the Jerusalem artichoke giving promising yields. Significance of the development lies not only in the possible necessity of eventually finding a substitute for gasoline, but also in the fact that the mechanization of agriculture during past years cut down the market for grain products, much of which were formerly consumed right on the spot. Power alcohol from crops would aid in any restoration of the balance.

ITEMS

TUSKS scattered on the frozen shore of Siberia opposite Alaska may mean that Soviet investigators will some day add more complete specimens of the extinct hairy mammoth to the two bodies already found. Like the first specimen found, the second body, which was uncovered

last October, was partially damaged by wild animals. The head, one leg and a part of the trunk had been partly eaten away. Otherwise the body was intact, preserved in the frozen earth. The tusks of the specimen have not yet been found, but they may be under its body, which has not yet been removed from the pebbly ground. Next spring, when the sea in this area is clear of ice, soundings of the coastal zone will be taken to see if a ship can approach the shore to take on board the find.

SCIENCE can hope to add about ten years to the present life expectancy in this country, making children born at some time in the future look forward to an average age of about seventy years. But gone are the days of very large additions to the normal life span, the achievement of nearly doubling the expected length of life which is the record in the 150 years since Revolutionary times. This is the verdict of Harold F. Dorn, U. S. Public Health Service statistician. The gains in life expectancy since the Revolution can be translated into some three billion years more life in the aggregate for those who happen to be living now. To-day the average boy born in the United States can expect to live to be 60.9 years, the average girl 64.4 years. If life expectancy is pushed to the maximum of 70 years, science must find a way to conquer cancer, diabetes, heart disease, nephritis and brain hemorrhage.

MAX E. NOHL, diver, who descended to a depth of 420 feet in Lake Michigan recently, withstood a pressure on his body of 320 tons more at that depth than he did at the surface. Atmospheric pressure of 15 pounds to the square inch adds up to about twelve tons when all the 3500 square inches of the average man's skin are considered. At 420 feet the pressure is about 197 pounds to the square inch. Dissolved gases in the human blood stream and body cells enable us to resist the pressure of the atmosphere. At shallow depths, compressed air helps a diver to resist water pressure, but as the pressure increases, nitrogen from the air dissolves in the blood stream, causing trouble if the diver comes to the surface too rapidly. "Bends," or caisson disease, a common and serious illness of divers, is caused by collecting nitrogen bubbles in the capillaries. These bubbles act as blood clots. To prevent this, an atmosphere of oxygen and helium, which causes fewer bubbles in the capillaries on ascending to the surface was used. If he descends to a depth of 500 feet as he plans to do in another dive, the pressure will be 380 tons more than at the surface.

VISIBLE supplies of cryolite, the essential fluxing mineral in the manufacture of aluminum by the present electrolytic process, will last at least fifty years more, according to Dr. Charles R. Toothaker, curator of the Commercial Museum, in Philadelphia. Reporting the findings of a recent mineral-collecting visit to Greenland in *Rocks and Minerals Magazine*, Dr. Toothaker describes the great pit in the shore of Arksuk Fiord from which the world's supply of this rare and valuable mineral comes. Administered by the Danish Government, the mine is worked only during the summer, the men returning to Denmark during the winter.

SCIENCE NEWS

Science Service, Washington, D. C.

THE MEETING OF THE AMERICAN ENGINEERING COUNCIL

THE welding of over 200,000 engineers of the nation into an articulate, coordinated group to advise the government and public on matters of large public works and other engineering projects and technology was advocated by Dean A. A. Potter, of the School of Engineering of Purdue University, speaking as president of the American Engineering Council at its recent meeting in Washington. Dean Potter urged that the profession take as active an interest in presenting non-biased opinion on engineering matters as does the American Medical Association on medical matters and the American Bar Association on legal questions. In its representative membership the American Engineering Council stands midway between the American Bar Association and the American Medical Association. The engineering societies represented on the American Engineering Council have a membership of 71,875 out of a potential 176,000 engineers who are eligible for membership in the societies. This is about 41 per cent. The American Bar Association has only 28,400 members out of 144,065 lawyers in the country, or a membership of less than 20 per cent. The American Medical Association has a membership of 102,715 out of a total of 140,398 medical practitioners in the country, or a membership of 72 per cent. In the opinion of Dean Potter the membership of the societies sponsoring the American Engineering Council should be as strongly representative as is the membership of the American Medical Association. But in any event it should be as articulate and as strong in molding public and legislative opinion as are both the lawyers and the doctors.

JAMES D. MOONEY, vice-president of General Motors Corporation, in an address before the meeting of the council, pointed out that the nation is nowhere near the saturation point of production and in the use of machinery and technology devices despite the opinion of some people to the contrary. Such cries against over-abundance and machines have come before and will come again, he indicated, citing an abstract from the 1886 report of the U. S. Commissioner of Labor, who said: "The nations of the world have overstocked themselves with machinery . . . far in advance of the wants of production. This full supply of economic tools to meet the wants of all branches of commerce and industry is the most important factor in the present industrial depression. Railroads and canals that are really needed have been built . . . harbors and rivers are sufficiently developed . . . water and gas works, tramways, etc., are largely provided. . . . The day of large profits is probably past." Fifty years ago the nation disregarded this pessimistic advice, said Mr. Mooney, and should do so to-day.

INDUSTRY may be able to raise the $25,000,000 suggested by Lammot du Pont to furnish employment for 3,000,000 men, but until science and technology provide new inventions and industries which can absorb this vast capital the road to future progress will be blocked, said Representative Jennings Randolph at a meeting of the council. "Direct employment for one million men would be provided, if each of 200 scientists and engineers could succeed in developing new industry-creating inventions and discoveries in 1938. Each industry thus created would have to employ an average of only 5,000 men and would require an investment of about $40,000,000. Two or three million additional jobs would be created as indirect labor. For this it is estimated that a total private investment of $8,000,000,000 would be needed. Even if only moderately successful, there is no doubt such an attempt would aid materially in solving unemployment." Congressman Randolph is sponsor of a bill providing for a government scientific research commission which would propose research work to be carried out in Federal laboratories or in the universities and colleges with Federal funds.—ROBERT D. POTTER.

THE DAILY AMOUNT OF ILLNESS

EVERY day throughout the winter 6,000,000 persons in the United States are too sick to work, attend school or pursue their other usual activities. This estimate of the amount of illness in the country is based on the results of the National Health Survey of the U. S. Public Health Service.

About 2,500,000 of the 6,000,000 on the nation's daily sick list are suffering from chronic disease such as rheumatism, diseases of the heart and blood vessels, hardening of the arteries, nephritis, cancer and non-malignant tumors, diabetes, asthma, tuberculosis, ulcer of the stomach, gall bladder diseases, nervous diseases and permanent impairments resulting from previous illness or accident. Colds, influenza, pneumonia and like diseases were the cause of illness in 1,500,000 of the 6,000,000. This is because the survey was made in winter when these diseases are most prevalent. About half a million were on the sick list because of accidents and another half million suffered from acute infectious illnesses or other acute illnesses such as appendicitis.

From 15 to 24 years is the healthiest age, according to this survey, the proportion of the sick in this age group being only 1 in 40. The highest proportion of sick was in the oldest age group, from 65 years and up. In this group one in every eight were disabled on the day of the survey. Children, and adults between 25 and 65 years had about the same proportion of illness. Illness occurs most often in the lowest income groups according to the survey. During the year of the survey, chronic illness of a week's duration or longer disabled two persons on relief for every one person in the middle and highest income brackets. Families just above the relief level but with incomes less than $1,000 had less sickness than the relief population but illness rate in this group was 17 per cent.

higher than for the highest income group. Most of this excess was due to the greater frequency of chronic illness.

Illness plays a big part in causing dependency, it appears from that part of the survey which showed how disabling illness incapacitates the wage-earner. In relief families one in every 20 family heads was unable to seek work because of disability. In non-relief families with incomes under $1,000 the number of family heads unable to seek work because of illness was one in 33. This figure was one in 250 for families in the comfortable income group. The relief and low income families not only have more illness but have longer-lasting illnesses. They also get less medical and nursing care than those with high or comfortable incomes.

EMANUEL SWEDENBORG

SCIENTIFIC MEN will join with philosophers, religious leaders and other men of learning all over the world to commemorate this month the two hundred and fiftieth anniversary, on January 29, of the birth of Emanuel Swedenborg. The reason is that Swedenborg, chiefly known as a philosopher and founder of a new religious movement, was a pioneer in many fields of science. Much of what we consider the revelations of strictly modern, twentieth century science was guessed at if not actually known to Swedenborg who died four years before the American Revolution. George Washington might be surprised to see planes circling over the capital city that he helped to lay out, but Swedenborg would not be. He published, in 1717, a description of a "machine to fly through the air" which the Royal Aeronautical Society of England has called "the first rational design for a flying machine of the airplane type."

The *Daedalian*, as Swedenborg called his flying machine, was only one of his many forward-looking ideas. He was the first to use mercury for an air pump. He worked out a method for determining longitude at sea by observations of the moon among the stars. His was the first attempt to establish a system of crystallography. Other Swedenborg "firsts," apparently, were his nebular hypothesis theory of the formation of the planets and the sun; his account of the phenomena of phosphorescence, and a molecular magnetic theory.

From physics and astronomy and geology, Swedenborg turned to the human body for scientific investigation. In his observations of the endocrine glands and his ideas of their function he was far ahead of his time. He conceived the modern idea that the activity of the brain is due to the combined activity of its individual cells and he attempted to divide the brain into different sections according to the various functions, even as modern investigators are trying to do. The spinal cord, Swedenborg decided, had a separate function from that of the brain. His theory of its rôle and of its relation to the brain have since been confirmed by modern science. These investigations led him to philosophical considerations, as they have led many another. The result of these latter observations of Swedenborg aroused more wide-spread interest and as a result seem to have somewhat obscured his scientific contributions. An observance meeting will be held on Wednesday, January 26, in New York, inaugurating the American commemoration of the Swedenborg anniversary.

ITEMS

THE goal of ancient alchemists—the transmutation of the elements—has been achieved by the atom-smashers of the laboratory so well that there remain only two chemical elements which have not yet yielded to the art of the modern scientist, according to Dr. K. K. Darrow, of the Bell Telephone Laboratories, speaking before a meeting of the New York Electrical Society. Before the days of modern transmutation the world consisted of some 25 kinds of atoms. Of these about forty were unstable atoms —like radium—which spontaneously disintegrated into other forms. "It looks now as though nature had already made almost all the stable forms of nucleus which are possible, while physicists, in a scant four years, have already made almost all the unstable forms which are capable of lasting as much as a few seconds." Already to the 40 radioactive forms of atoms found in nature modern science has added no fewer than 220 others by the art of transmutation.

WORKERS at the Field Museum of Natural History are engaged in assembling the only complete skeleton of *Megatherium lundi*, a species of South American ground sloth extinct for 1,000,000 years. The specimen, being prepared under the direction of Phil C. Orr, will be ready for exhibition within a few months. Collected on an expedition to Argentina and Bolivia headed by Elmer S. Riggs, curator of paleontology, it is declared to be of great importance in the study of extinct types of mammals. The great ground sloths, of which this is a mountain species, were ponderous, clumsy beasts, with long hind legs and shorter forelegs. In appearance of head and body they resembled the bear in some respects, but many of them were larger than elephants. They could stand almost erect on their hind legs, and reach high into the trees, clawing off leaves for food with their forefeet.

AN Oxford zoologist, John R. Baker, proposes a set of season words that will have the same meaning everywhere. They are intended primarily for convenience in discussing things like the migration and nesting of birds, but they are based on an astronomical system. Thus, that part of the year when the sun is south of the equator and going south Mr. Baker proposes to call Notodune, which comes form two Greek words that mean, roughly, "towards south." A companion-word, used for the time when the sun is still south of the equator but heading north, is Notopheuge, which is translated as "away from south." Analogous words applying to the Northern Hemisphere are Boredune and Borepheuge. Then there are four more words, that have to do with the sun's travels relative to the observer himself. If in the same hemisphere as the observer and going to the pole of that hemisphere, it is Homodune; if away from that pole, Homopheuge. And for the hemisphere away from the observer the corresponding words are Heterodune and Heteropheuge.

SCIENCE NEWS

Science Service, Washington, D. C.

ADVANCES IN ELECTRICAL AND CIVIL ENGINEERING

A PEEK into the future of long-distance telephonic communication was given at the recent meeting of the American Institute of Electrical Engineers. Developments in the use of existing telephone wires as guide paths for carrier waves has made it possible to have twelve messages going over the same wire without interference. Two engineers from the Bell Laboratories, C. W. and E. I. Green, discussed new details of the carrier system for toll cables. The new advances are the culmination of a long-range program of applying high frequency waves to wires. Early developments utilized special wires, but the new work has succeeded in using existing cables, both aerial and underground. "Plans already under way call for the application of large numbers of these systems to meet the rapid growth in long-distance traffic. There is every indication that, taken collectively, these broad band systems will have far-reaching effects upon the toll telephone plant of the Bell System. A transition is already under way from the time when carrier (waves) was used only on open wire, and comprising only a small part of the toll plant, to a time when carrier systems will furnish a major part of the toll circuit mileage of the Bell System."

THE ultimate solution of the controversial question of the costs of electrical power will come only after all hysteria has been removed from the discussion, is the opinion of John C. Page, Commissioner of Reclamation, at the symposium of the subject recently sponsored by the American Society of Civil Engineers. Thus was set the keynote of the conference in which the engineers sought to appraise the social and economic consequences of the things which their technical ingenuity has wrought. "Thought on the subject of power," said Mr. Page, "ranges from that of the evangelist who believes power should be as free as the air, to that of the tycoon who views power as the silver spoon meant for the mouths of those born to the economic purple. The engineer, as a professional man, has spent much of his time with the formulae of the power industry, but has devoted too little of his thought to the implications, social or otherwise, of what he has wrought." Mr. Page called on engineers to forget their prejudices and give the problem the same impartial study which they show in their design and building. Public agencies have demonstrated their ability to manufacture and distribute power efficiently in many localities. Likewise, he added, private enterprise has demonstrated the same fact in other places. This means that there is nothing inherently bad in either public or private ownership of electrical utilities, which an unprejudiced study can not overcome.

NEW YORK CITY is preparing now to solve the gigantic traffic problems of the 1939 World's Fair at which 40,000,000 to 50,000,000 visitors are expected. Daily attendance will average 250,000 persons, according to the report of Colonel John F. Hogan, chief engineer of the Fair, at the meeting of the American Society of Civil Engineers. On many days 600,000 will attend and on the maximum day there should be approximately 800,000 visitors. Over 160,000 people an hour can be handled by the terminal facilities now being created. Of these 115,000 will come by rapid transit—train, subway or trolley—and 45,000 by motor vehicle. Half of the Fair's 1,200 acres will consist of the world's largest parking lots. On peak days 21,000 automobiles can be parked simultaneously and 35,000 handled during a single day. Within the fair grounds three types of transportation will be available: 1. Buses seating 60 people will cover over four and a half miles of route. 2. Over streets not served by this first system there will be trains of 4 or 5 cars seating 10 people each. 3. Individual service for two or three people in independent vehicles driven by trained guides.

MECHANICAL and electrical ingenuity are tackling that most baffling of all accounting systems—the modern department store with its thousands upon thousands of daily transactions. At the meetings of the American Institute of Electrical Engineers in New York, Professor L. F. Woodruff, of the Massachusetts Institute of Technology, described a system of electric remote-control accounting which takes only five seconds of a customer's time and yet which sets into operation robot mechanisms that give a store a constant check on the merchandise it sells. The time-consuming process of making out sales slips is completely done away with. The new system is an extension to a new and difficult field of the well-known punch card system of accounting which has been used for some years. By punching holes in coded positions on cards it is possible to record thousands and millions of separate data. Large corporations, the U. S. Census Bureau and other agencies handling millions of individual units find the punch-card method extremely valuable. Literally billions of these cards are used yearly in the nation. Their advantage lies in the fact that by feeding them through automatic machines one can—in the case of the census—adjust the machine so that all persons whose names begins with W–A–L, who are married, have two children, have a job and who were born on June 12, 1907, can quickly be sorted out from the millions of individual cards for each person in the nation. Such sorting machines can handle 400 cards a minute and other machines which tabulate results can operate at speeds of 150 cards a minute. Such is a typical prior use of these cards and their accessory machines. The new adaptation operates such a system by remote control, electrically. It makes possible practically an instantaneous and continuous recording of sales of all varieties.

A SEPARATE and new branch of the government, a Federal Department of Public Works, was urged by speakers

addressing the opening sessions of the American Society of Civil Engineers. In normal prosperity years construction is the second largest industry in the nation. From 1926 to 1933 the yearly average expenditure for construction was $9,000,000,000, and directly or indirectly employed five million men. As the bottom dropped out of private construction, the Federal Government, through WPA and many other agencies, stepped into the breach and gradually assumed a larger and larger place in the nation's construction industry. The function of a Department of Public Works, said Alonzo J. Hammond, Chicago consulting engineer and a past president of the society, would be to coordinate and effect economies in the ramified building of the government which is now scattered through many departments. Surveys made in the past estimate that $50,000,000 might be saved for every billion dollars spent for public works by a unified and coordinating control. Virtually every type of building by the government, except the military works of the War Department, would be in the province of the proposed department. In 1924, representatives of 60 separate engineering organizations met in Washington and recommended such a department. Herbert Hoover, then Secretary of Commerce, urged the formation of the department not only because it affected saving in planning and operation costs, but also because its value "would be more in leadership for the great balance wheel of construction which lay in government construction work."

THE RADIOACTIVE DISINTEGRATION OF POTASSIUM

NATURE "changed the rules of the game" of radioactivity ten billion years ago, probably long before the earth was formed. It was then that potassium, an element essential to life, began disintegrating radioactively, Dr. A. K. Brewer, chemist of the U. S. Department of Agriculture, has determined. Measuring the rate of breakdown of potassium into a kind of calcium, a component of limestone, then determining the time that this breakdown has been going on from the amount of this calcium now existing, Dr. Brewer finds that the process has been going on for about ten billion years. In reaching this figure, he assumes that all this special calcium, which has an atomic weight of 40 instead of 40.08 as does ordinary calcium, was derived from the breakdown of potassium, and that the breakdown rate has been uniform since it started. A similar time has elapsed since a variety of rubidium, a rare earth, started to break down into a kind of strontium, another rare earth.

Attempts to determine our planet's age by studying the end products of radioactive breakdown, such as calcium derived from the decay of potassium, may be as futile as trying to find out how old a stove is by weighing the ashes. What the method will show, Dr. Brewer believes, is how long the disintegration has been going on, or more simply, how long the fire has been burning. Dr. Brewer's new studies in no way affect the ages determined for a number of rocks by radioactive methods. The amount of uranium, another radioactive element, in rocks is measured and then compared with the lead which it has added to the rock by uranium's previous decay. The oldest rocks, dated by this method, are about one billion, five hundred million years old.

With earth age estimated from a number of sources at not more than 2,500,000,000 years, some of the breakdown of potassium must have occurred before earth was formed. Under present theories, the breakdown began on the sun, seven or eight billion years before the little star was torn apart to create the solar system. How matter behaved under the old rules, in force until ten billion or so years ago, before the formation of the solar system, Dr. Brewer will not state. His studies give no clue to older, now-nonexistent states of matter. Studies of the ages of rocks, using radioactive potassium as the "clock," indicate to Dr. Brewer that their age can not exceed six billion years, and probably they are very much younger. Disintegration long ago of other elements, now completely broken down, may make this age entirely too large. More work on radioactivity, leading to a more exact, and probably smaller value for rock age, is suggested by Dr. Brewer.

WILDLIFE PRODUCTION ON PRIVATE LANDS

WILDLIFE must be produced on privately-owned farm land as well as on lands publicly owned if America's bird and game resources are to be perpetuated, Dr. Ira N. Gabrielson, chief of the U. S. Biological Survey, states in his annual report to the Secretary of Agriculture, made public recently.

Publicly owned lands, despite the fact that large additions have been made during recent years, are not sufficient to perpetuate species of wildlife.

Dr. Gabrielson's report, which covers the year ended June 30, notes that 600,000 acres of refuge land were purchased during the fiscal year covered in the report, while more than half a million acres were held pending title conveyance. Almost a million acres were added by executive order.

Tons of duck-food plants and millions of food-bearing trees and shrubs have been placed in refuge areas to make the area attractive to wildlife, the survey director continues in explaining the wildlife rehabilitation work, which has been one of the survey's chief activities during the past few years. Despite the wide program being carried out, however, a study of wildlife management as a farm enterprise indicates that state and federal lands alone can not supply sufficient wildlife or adequate facilities for its use and enjoyment by the public.

The necessity for severe restrictions on hunting has not passed. Benefits of strict regulation are shown in the fact that some waterfowl increases have now been noted for two consecutive years. On June 30 there were 216 federal refuges in the United States with an acreage exceeding 7,000,000 and 15 refuges in Alaska, Hawaii and Puerto Rico raised the total above 11,500,000. Acquisitions during the last year included areas for 70 refuges in 32 states and Alaska. Wildlife populations of the refuges have already increased threefold. Planting and transplanting, building water-conserving structures and other activities by the Civilian Conservation Corps and Works Progress Administration have aided the program.

Since July 1, 1933, when the present program began, the survey has purchased 1,500,000 acres of refuge lands. In the same period more than 4,000,000 acres have been acquired by executive order. Increase of wildlife depends, providing hunting is regulated, on the amount of land available for wildlife. It is for that reason that the use of private lands for wildlife production is urged.

ITEMS

LIKE a giant toadstool, with a copper top and an insulating-tubing stem, a baby atom-smasher, designed to work at only 450,000 volts, less than one tenth the power of the larger models, has been demonstrated by Dr. Phillips Thomas, research engineer of the Westinghouse Company. Charges of electricity, carried up to the copper top by a moving belt, just as a water tank is filled by a bucket-type chain conveyor, slowly load the insulated metal electrode, until the charge is enough to force sparks out into the air. In the larger atom-smashers, the charges are used to push sub-atomic particles through a long vacuum tube and into atoms at the other end, disrupting them, and giving clues to the construction of matter. Another device demonstrated by Dr. Thomas is called the Precipitron. It "electrocutes" dust by charging it with electricity and then attracting the charged particles to a metal plate. Smoke particles blown past a charged wire took up an electric charge and stuck to metal plates oppositely charged as though glued. Already in experimental operation in several cities, the Precipitron is designed to remove more than 99 per cent. of dust, smoke and bacteria from the air it treats.

SPONGY iron that is soft and malleable like lead and employable for some of the same purposes has been developed in Berlin by a physicist, Dr. Hans Vogt, after many years of effort. The material has the further advantages that it is much lighter, lower in price, and can be produced from native ores instead of being expensively imported from abroad. One of the common uses of lead is for packing around iron plumbing; it is hammered into joints between the pipes. The new spongy iron is very well adapted for this use. This "kneadable" iron is made by sintering powdered iron at a temperature of from 1,200 to 1,300 degrees Centigrade, in an atmosphere of hydrogen to prevent the formation of oxides. The product is full of tiny cavities, to which it owes its plastic properties.

A PATENT has been granted by the U. S. Patent Office on an electric light which, its inventor claims, will not blacken during its lifetime of use. A built-in screen to prevent vaporized metal from the filament from reaching the inner glass surface of the bulb features the invention, patented by Richard E. Smith, of East Cleveland, Ohio, and assigned by him to the General Electric Company. Blackening of the bulb surface, which cuts down on the amount of light given out by the bulb, is considerable, particularly in the gas-filled type in general use. The surface becomes blackened through the fact that molecules of the metal filament, heated to incandescence by the electric current, are carried by convection currents in the gas until they are deposited on the relatively cool glass surface.

A NEW remote control device for radio receivers which can turn on or off a set, raise or lower the volume and select any of six stations was demonstrated at the New York meeting of the Institute of Radio Engineers. The significant point is that this robot control involves the use of no bulky wires lying on the floor as are now needed for apparatus with equivalent ability. Engineers S. W. Seeley, H. B. Deal and C. N. Kimball, of RCA Licensee Laboratory, New York City, demonstrated the new equipment. The robot control device is essentially a tiny radio oscillator generating a radio wave longer than those used for ordinary broadcasting. The long waves are impressed on the 60-cycle alternating current power line operating the radio receiver and thus reach the set. There they activate suitable relay mechanisms which can do different jobs. By using three frequencies between 200 and 400 kilocycles and two phase relations it is possible to have the robot control do 26 different things. Impressing radio signals on a wire already carrying current is the basis of the so-called "wired radio" which has proved experimentally successful but never put into commercial broadcasting. It is the basis, too, of the enormous message-carrying capacity of the new coaxial cables to be used in television.

JACKRABBITS, prairie dogs, gophers and kangaroo rats which destroy forage intended for livestock which roam the 142,000,000 acres set aside for conservation purposes have been almost entirely eliminated from many tracts in the grassland area, according to Director F. R. Carpenter, of the Division of Grazing, U. S. Department of Agriculture. Extermination work on more than 5,500,000 acres of public domain in nine western states has reached the point where the depredations of the pests no longer constitute a major menace to the well-being of the animals feeding off the pastures, it was stated. Members of the Civilian Conservation Corps, who have cooperated in carrying out the rodent-exterminating program, and the Division of Grazing will need to make only minor clean-ups during the coming year to keep those sections of the range free of rodents. Studies, indicating the economic value of the campaign, show that 80 kangaroo rats or gophers will eat more forage than a 750-pound cow or three sheep. During one invasion of grassland areas in Arizona 80 per cent. of the blue grass crop was destroyed.

ILLITE, a mica-like mineral, resembling ordinary mica, but occurring in sedimentary rocks, is announced as a new mineral by Drs. R. E. Grim, R. H. Bray and W. F. Bradley, of the Illinois Geological Survey, reporting in *The American Mineralogist*. Long mistaken for other minerals which it resembles, illite has been called mica, sericite, hydro-mica and glimmerton. Now, as a result of an exhaustive study, in which an x-ray determination of the crystalline structure was made, illite is found to be a new mineral. Illite is a common constituent of many shales, silts and sandstones. Its discovery may lead to a better understanding of the causes of the formation of mica in old sediments after they have been heated and compressed.

PIONEER OF THE AIR

FOUNDED IN 1919, the Radio Corporation of America has completed 18 years of pioneering effort to develop and improve the uses of radio.

Starting "from scratch," RCA has created a world-wide communications system with direct circuits between the United States and 42 foreign countries, and with ships at sea. It has created a nation-wide broadcasting system of endless cultural possibilities, now rapidly expanding its services by short-wave to all the world. It has created essential instruments for the radio transmission and reception of sound, of code messages, and of facsimile reproductions, and for the recording and reproduction of sound on records and on motion picture film. It has created countless radio devices indispensable to modern science, industry, medicine, telephony, and public safety. It has created the basis for a system of electronic television, forecasting the day when radio sight, added to sound, will perform a useful public service.

Today the Radio Corporation of America is owned by nearly a quarter of a million stockholders in 48 states. No one person owns as much as ½ of 1% of its stock. Achievements of the past 18 years are a tribute to the American tradition of service in the public interest through private initiative and ownership.

RCA presents the "Magic Key" every Sunday, 2 to 3 P.M., E.S.T., on NBC Blue Network.

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SCIENCE NEWS

Science Service, Washington, D. C.

SOME PAPERS READ AT THE INDIANAPOLIS MEETING OF THE AMERICAN ASSOCIATION AND ASSOCIATED SOCIETIES

THE retiring presidential address before the American Association for the Advancement of Science, delivered on December 27 by Dr. Edwin Grant Conklin, professor emeritus of biology at Princeton, executive vice-president of the American Philosophical Society and president of Science Service, was printed in SCIENCE on December 31. Terming "dull and fruitless" attempts to make science the handmaiden of religion, Dr. Conklin emphasized that science was vitally concerned with ethics, "the religion of science." The words expressing the ethics of the great scientists, among them Pavlov, Pasteur and Tyndall, were shown by Dr. Conklin to contain ideals of conduct and character similar to that taught by great religious leaders. Often the substitution of the word "Truth" for "God" will bring them into agreement. Militarists and dictators have no right to seize upon Darwin's principle of natural selection as justification of their philosophy that might makes right. "Darwin himself repudiated this extension of his principle to the struggle between races and nations of men. Those who attempt to extend it into the field of intellectual, social and moral qualities should remember that the standards of fitness are wholly different in these fields. Physically the fittest is the most viable and most capable of leaving offspring; intellectually the fittest is the most rational; socially the fittest is the most ethical. To attempt to measure intellectual or social fitness by standards of physical fitness is hopelessly to confuse the whole question, for human evolution has progressed in these three distinct paths. Man owes his unique position in nature to this threefold evolution, and although the factors of physical, intellectual and social progress are always balanced one against another, they are not mutually exclusive." Intelligence has become a prime factor in evolution. Human selection, as practiced either by the hit or miss process of "trial and error" or the vastly more rapid and less wasteful method of remembered experience, is just as natural as the "natural" variety to which Darwin devoted most attention. We are continually improving on nature, as shown in agriculture, industry, medicine and education. To the recent statement by Dr. Robert Maynard Hutchins, president of the University of Chicago, that science is a failure in the educational process, Dr. Conklin replied: "Those who have never experienced the discipline and ennobling effects of scientific studies fear that science will destroy our civilization and are calling upon educators to repent and to return to the good old subjects of classical learning. It was not science that caused the decay of former civilizations, nor was it in the power of classic art, literature and philosophy to save those civilizations. Certainly there are no other studies than science that distinguish so sharply truth from error, evidence from opinion, reason from emotion; none that teach a greater reverence for truth or inspire more laborious and persistent search for it. Great is philosophy, for it is an attempt at a synthesis of all knowledge, but if it is true philosophy it must be built upon science which is tested knowledge." "In its practical aspects," said Dr. Conklin, "the ethics of science includes everything that concerns human welfare and social relations; it includes eugenics and all possible means of improving human heredity through the discovery and application of the principles of genetics; it is concerned with the best means of attaining and maintaining an optimum population; it includes all those agencies such as experimental biology and medicine, endocrinology, nutrition and child study, which promise to improve bodies and minds. It includes the many scientific aspects of economics, politics and government; it is concerned especially with education of a kind that establishes habits of rational thinking, generous feeling and courageous doing."

PROFESSOR H. M. RANDALL, of the University of Michigan, from a lifetime study of the far infra-red region of the spectrum, assembled for an exhibit shown at the Annual Science Exhibition strange and little-seen equipment used to generate and detect the rays. This radiation is neither heat rays nor radio waves but a cross between the two. It will pierce layers of black paper and appreciable thicknesses of hard rubber. Ordinary receivers like photo-electric cells and common thermopiles will not detect its presence. Radio receivers are also useless. Crystals of rock salt, rather than glass, must be used to bend the far infra-red rays in studies of its properties. Grating lines scratched on crystals are also used. One feature of Professor Randall's exhibit was a ruling machine, in operation, that cuts grating lines in spacings varying from 25 lines to 1,200 lines to an inch. The source of the radiation which comprises "No Man's Land" is the energy released by molecules as their atoms vibrate like two or more balls at ends of a spring. In the remote region of the far infra-red even the minute amount of energy released as the atoms in the molecule rotate, one about the other like a spinning dumbbell, is responsible for radiation.

THE instruments for detecting and studying cosmic rays were also exhibited. Professor Arthur H. Compton, of the University of Chicago, and Professor Robert A. Millikan, both Nobel prize winners and both authorities on the cosmic ray, showed operating exhibits of their equipment.

PROFESSOR HAROLD C. UREY, of Columbia University, showed the equipment used to concentrate and detect the presence of those rare chemical forms of matter, the isotopes. For detecting heavy hydrogen, Professor Urey won the Nobel prize. More lately he has been working on the concentrations of the isotopes of nitrogen and of oxygen. Hydrogen, nitrogen and oxygen are chemical elements having the greatest importance to the world

and life on it; all are found in the human body. Dr. Urey's exhibit shows samples of water which have an increased concentration of the mass 18 isotope of oxygen approximately 4.5 times that in normal water.

FLOWERS that ordinarily would fade overnight can be made to keep their living beauty unfaded for a whole year under treatment reported by Professor Carl D. LaRue, of the University of Michigan. First the flowers had to be sterilized, a task very difficult to accomplish without injury to their delicate beauty. Bromine water, quarter strength, used for from two to ten minutes did the trick. Then the flowers were placed in agar containing sugar and essential mineral salts. They not only lived, but actually grew roots and formed new plants.

PROFESSOR A. C. KINSEY, of Indiana University, exhibited an insect collection which numbers over 5,000,000 specimens. Professor Kinsey showed special mountings of galls and gall wasps which have been collected for more than 20 years in the United States, Mexico and Guatemala. This collection is of outstanding use to entomologists, because through it can be traced the process of evolution in insects, the alteration of generations, and the production of offspring by unmated females.

PROFESSOR ROBERT CHAMBERS, of New York University, pointed out that microdissection, the science and art of dissecting minute tissues under high-power microscopes, has pointed the way toward solution of one of the oldest and most important riddles of modern science. Does the tiny darkish spot in each cell, the nucleus, traditionally referred to as the "soul" or "brain" of each individual cell, exert a continuous influence on the cell? Or is its activity limited to the time when each cell is reproducing itself by dividing into two cells? An experiment in which it is indicated that the cell's "brain" plays a vital part in the cell's activity was reported by Dr. Chambers in the course of his review of protoplasm, the material of which cells are fashioned. Fibrocyte cells, which are found commonly in connective tissue, frequently have two nuclei apiece instead of the more usual single nucleus. Destruction of the second nucleus by means of microdissection results in the shriveling of the punctured nucleus and the disintegration of the surrounding cell material. But after several minutes the disintegration ceases and in an hour the cell, now with only one nucleus, is again healthy. This experiment, with the visible disintegration of cell material, is taken by Professor Chambers to indicate that the cell's "brain" is acting continuously on the cell.

FURTHER advance in the knowledge of cancer and its eventual subjugation, a potent aid in the treatment of severe burns, and better understanding of the nature of life and cell growth, are all bound up in the discovery of substances produced by injured cells which cause the rapid multiplication of healthy cells. These substances, provisionally named intercellular hormones, were demonstrated by John R. Loofbourow, of the Institutum Divi Thomae, Cincinnati. The steps in the demonstration were simple, direct and complete. Under one microscope were cells of yeast, with other cells of yeast, uninjured, separated from them by a layer of jelly-like material, agar-agar. Nothing especial was happening in this culture. Under the next microscope was a similar mounting of yeast cells, with the important exception that the lower cells had been injured by prolonged exposure to strong ultra-violet radiation. Here, something emanated from the injured cells, passed through the separating layer and stimulated the healthy cells into exceedingly rapid multiplication. A third microscope showed yeast cells in a similar state of rapid proliferation. These, however, had not been treated directly with injured cells, but with an extract taken from such cells. In a tiny tube near-by were a few yellowish crystals, purified out of injured-cell extract. Mr. Loofbourow stated that these crystals have not yet been analyzed. Preliminary steps in analysis indicate that they consist of the higher chemical fractions of proteins. But that does not tell much as yet. Many kinds of injured cells, both plant and animal, have been shown to be capable of yielding the new intercellular hormones. They cause rapid growth or proliferation of a wide variety of uninjured cells. Of especial interest, from the practical point of view, is the stimulation of two kinds, fibroblasts and epithelial cells. Fibroblasts are cells typical of one kind of cancer. Epithelial cells constitute an important part of the complex we know as the skin, as well as the covering of other, internal body surfaces. The ability of the new-found substances to make these grow and spread rapidly has already been turned to account. For the past year, they have been used at St. Mary's Hospital, Cincinnati, in the treatment of third-degree burns. Burns thus treated heal up in a minimum of time and without the wide areas of disfiguring scar tissue that usually follow such injuries.

THE seat of human consciousness and with it the ability to speak is located in the brain's artery in the left front side of the head, Dr. William H. Thompson, of the Municipal University of Omaha, reported to the association, after reviewing operations performed by brain surgeons. Amazingly large amounts of a person's brain can be removed if necessary without seemingly affecting his ability to lead a normal life and carry on his business. The right cerebral hemisphere of the brain, for instance, has been removed with no observable permanent loss of the higher mental processes. Surgeon's knives have whittled away other portions of human gray matter, previously thought essential in the control of mental functions, and the patients hardly knew anything had happened to them. But if the left anterior cerebral artery is injured by any chance the patient can never regain consciousness. This area and the flow of blood seems linked with the problem of conscious existence itself. Investigators are now searching for some practical way of studying these new aspects of the age-old problem of relationship between mind and body.

DR. P. S. SHURRAGER, of the University of Illinois, reported that the origin of the brain waves is shown in the records of the death process. In death the lower creatures such as fish, frog and toad become like the higher animals, the guinea pig, cat and dog, in the electrical responses of their brains. From this fact, Dr. Shurrager

infers that the brain's electrical waves have their origin in the life processes of the cells of the brain. Each single cell in the brain may in the course of its life process create electrical impulses which are added together algebraically to create the complex brain waves broadcast from the brain's surface. The life process of the brain cell consists in the building up of negative electric charges in the brain fluids which surround each cell until these negative ions become numerous enough to disrupt the membrane of the cell. When this happens, a spontaneous nerve impulse bursts from the cell and goes out along the nerve fiber. With this there is a neutralization of the negative charges in the surrounding fluids and the whole process starts again. Thus it repeats over and over. As death approaches, the complex brain wave rhythms become slower and decline in amplitude. Those of different living creatures become more alike and fade to a few millionths of a volt; they lose their distinctive character.

OUR Stone Age ancestors had plenty of dental trouble. This information, contradicting wide-spread ideas that primitives, eating rough and raw foods, always had perfect teeth, was laid before the association by Professor W. M. Krogman, of Western Reserve University. Nor are primitive men to-day at all free from toothaches and the holes and faults that cause them, he added. It is true that dental caries is rarer in the oldest human skulls, and that its incidence increases as one comes down the line toward more recent times. In the Old Stone Age, over a hundred thousand years ago, the frequency of dental caries ranged from 5 to 20 per cent. In the New Stone Age, twenty thousand years ago, the frequency rose to a range of 15 to 45 per cent. "In the next succeeding ages the frequency rose, until in 3500 B.C., just before the dawn of history, an early Iranian (Persian) people showed as high as 75 to 90 per cent. of the entire adult population afflicted with dental caries—a frequency as high as that of any 'civilized' group to-day." The false notion that primitive man always had perfect teeth got its start because archeologists and curators always picked out "pretty" skulls for museum display. Now they keep the imperfect specimens too—and frequently learn more from faults than they do from perfections. Professor Krogman pointed out that not civilization as such, but domestication, is the thing that has played havoc with man's teeth, and domestication started thousands, perhaps millions of years ago.

DR. JAMES VAUGHN, of the University of Cincinnati, gave the Rorschack ink blot test to 43 patients in mental disease hospitals, all of whom had paranoid tendencies and thought people were persecuting them when they were not. He also gave it to 52 college students. He found that many of the apparently normal students showed unusual character in the forms they saw, for seeing such forms has been taken as an indication of mental derangement. Dr. Vaughn said that "One can hardly escape the conclusion that insanity is a difference in degree and not in kind."

AFTER the possible influence of size, shape, color and other features had been eliminated, Dr. Ansbacher, of Columbia University, in an investigation using postage stamps, was able to prove that sheer acceptance of the stamp as a stamp of one's own country gives it an apparent size greater than that of the stamp of some other country. If the trifling matter of postage stamp size is affected in this way, how fundamentally, argues Dr. Ansbacher, is our personality as a whole determined by the people and surroundings in which we live and are reared.

YOUTH has given the world its greatest advances in medicine, surgery and sanitation, according to Dr. Harvey C. Lehman, of Ohio University, at Athens. Most such scientists are under forty when they make their great discoveries. But Dr. Lehman, who is forty-eight, reminded his audience that it is possible for the individual to think creatively and to make highly useful contributions at practically every chronological age beyond early childhood.

EXTRA-SENSORY perception and the pros and cons of telepathy and clairvoyance as propelled upon the American scene by the parapsychological researches of Dr. J. B. Rhine, of Duke University, and recent radio programs plugging ESP experiments, were discussed in the scientific sessions and in informal conversation. One paper that from its title dealt with methods used in recent radio telepathy tests was replaced at the last moment by a paper not related to this subject at all. Another paper before the mathematicians titled "A Source of Error in Interpretation of Experiments on Clairvoyance" was not given because of illness of the author, Professor Harold Hotelling, of Columbia University. Instead, a paper by the Harvard mathematician, Dr. E. V. Huntington, was substituted. He finds the mathematical methods used by Dr. Rhine in analyzing his scores, subjected to attack by psychologists, are "good enough for his purposes," although his methods "can not bear close analysis." "I hate to see the prestige of mathematics called into question by psychologists," Dr. Huntington said, as he presented the meeting with a sort of mathematical score card for the use of those playing the ESP game. "This doesn't mean you have demonstrated the reality of telepathy, does it?" Dr. Huntington was asked. And his answer was that it did not. Joining in the same attitude was Professor Burton H. Camp, of Wesleyan University and president of the Institute of Mathematical Statistics, who declared that if the Rhine investigation is to be fairly attacked it must be on other than mathematical grounds. There was evident disappointment among psychologists that more conclusive discussion of ESP did not occur at these meetings. A possible explanation of ESP ability was presented in a discussion at the mathematical session by Professor Henry Schultz, economist of the University of Chicago, who reported that members of the Chicago faculty playing ESP were able to train themselves to make high scores through images appearing on the backs of cards. Dr. John L. Kennedy, psychical research fellow at Stanford University, reported that he had repeated the debated ESP tests of Dr. Rhine, using a hundred subjects. Only one made a record above what would be expected by chance or accident. And that young man, whose scores compared

with Dr. Rhine's best, was found to be using unconsciously some slight differences in the look or feel of the backs of the cards.

A PERSON with migraine headache is on a perpetual emotional drunk, according to Dr. Milton B. Jensen, consulting psychologist of Louisville, Ky. Simple habits of becoming extremely excited over everything or nothing were blamed by Dr. Jensen with this puzzling and painful type of headache without organic cause. In his or her emotional sprees, the individual tenses his muscles so that he produces a partial anemia in the brain by reducing the circulation of the blood. The headache results from a stretching of the blood vessels in the brain. Sex can not be blamed for migraine, Dr. Jensen said. "Sexual maladjustment bears no causal relationship to the onset, duration, frequency or severity of ordinary migraine headaches. Maladjustment to sex does not cause the headaches and the headaches do not cause sexual maladjustment." Too much excitement in the home during childhood, improper rest and acquired habits of incessant nervous excitation were held responsible. Dr. Jensen cited cases where the headaches cleared up when the sufferers learned to control their emotional responses.

SCIENTIFIC men were called upon to assume social responsibility for the consequences of their inventiveness, lest they find themselves in the subservient position of German scientists. Dr. Eduard C. Lindeman, of the New York School of Social Work, pointed out that "a technological age can not afford to have its values set by persons unfamiliar with the foundations of science and technology. Science must become much more forthright in accepting its social responsibilities and especially the responsibility for understanding basic human needs and for releasing the unused energies of men. Education must become more scientific, both with respect to its methods and purposes."

ONE out of six people in the United States could disappear to-morrow without affecting the national income of the nation, according to an inquiry that provides preliminary blue-prints for more effective use of human resources and manpower. Some 15,000,000 to 20,000,000 people live at a subsistence level and take a very meager part in economic life, a paper communicated by Frederick Osborn, of New York City, stated. These people, representing probably some of our finest stocks, are located in the Appalachian Highlands, the Ozarks, the cut-over regions of northern Michigan, Minnesota and Wisconsin, and they include marginal farmers and sharecroppers in the South and the western wheat areas. The unemployed in our cities are also in the class of our population that neither produce nor consume in the sense of any broad exchange of goods. One of the major tasks of society is to change these people into effective producers and consumers. "If all our people could be brought to the level of the twenty-five per cent. who are at present our largest consumers, our total economic activity could be increased manyfold."

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SCIENCE IS PRINTED BY THE SCIENCE PRESS PRINTING COMPANY, LANCASTER, PENNSYLVANIA

Estimates for printing scientific books, monographs and journals supplied on application.

SCIENCE NEWS

Science Service, Washington, D. C.

A NEW HIGH-TEMPERATURE FURNACE

A FURNACE which utilizes electron bombardments to produce temperatures up to 4,500 degrees Fahrenheit, half as hot as the sun, is being used at the Harvard Graduate School of Engineering to study the basic physical properties and possible industrial uses of 40 metals at present little understood and used.

In announcing the research program it was pointed out that of the 55 metallic groups only 15 have been fully utilized by industry. From ancient times gold, silver, iron, copper, tin, zinc, lead and mercury have served in many ways. Within more recent years aluminum, antimony, bismuth, cadmium, chromium, cobalt and nickel groups have been added to the earlier list. But there still remain 40 metal groups, whose alloy characteristics have yet to be studied, and whose possible industrial application is still in its infancy. Their development may mean as much to industry as the relatively recent development of such alloys as stainless steel, or the tungsten carbide used in high-speed machinery.

The new furnace was invented by Dr. Ralph R. Hultgren, instructor in metallurgy, who has been constructing the apparatus during the past year. Its chief advantage is its ability to eliminate entirely the contamination, by carbon or other metals, which has marked other furnaces. The familiar carbon arc, for example, reaches as high temperatures as the electron furnace, but is markedly inferior as an experimental device because carbon gets into the melted metal, and there is no way of keeping it out. Much higher temperatures than 4,500 degrees could easily be reached by this furnace if better crucibles could be obtained to hold the metals under study. Those now used are made of tantalum lined with thorium oxide and are good only to their melting point, about 5,000 degrees.

The electron bombardment principle has previously been utilized for intense heat in several other fields but the new furnace marks its first application to metallurgy. The furnace consists of a small cylindrical metal cup or crucible, about a half inch in diameter and height, and two filament wires on opposite sides of the crucible. The metal to be studied is placed in this cup and an airtight cylindrical hood, about 10 inches in diameter and 15 inches high, is placed over the apparatus. A powerful vacuum pump reduces the pressure under this hood to about one billionth of ordinary atmospheric pressure. The crucible is then raised to an electrical potential of 2,500 volts. As in the ordinary vacuum tube, this causes electrons to flow from the wire filaments across the vacuum gap to strike the crucible. The heat of the furnace is built up by the energy of these electrons, converted into heat upon hitting the crucible; a conversion precisely similar to the production of heat by hammering metal. Although the energy of each individual electron is infinitesimal, the cumulative pounding of millions of them attracted by the crucible charge produces intense heat.

VOLCANIC ERUPTIONS AND MINERAL DEPOSITS

BOILING floods of lava and glowing clouds of gas are not the only products of volcanoes. Many volcanoes have brought useful and valuable minerals—gold, silver, diamonds or oil, close to the surface where they are accessible. Recenty, reporting his field findings to the Geological Society of Washington, Dr. A. H. Koschmann, of the U. S. Geological Survey, told of the Cripple Creek volcano near Pikes Peak, Colorado, whose eruption 25 million years ago brought millions of dollars worth of gold into the rocks near the surface, where it could be reached by mining operations.

Near Silverton, Colorado, a similar volcano brought 250 cubic miles of new material to the surface at about the same time as the Cripple Creek eruption. Dr. W. S. Burbank, also of the U. S. Geological Survey, stated that this created the famous Camp Bird mining area, which built the fabulous fortune of the late Tom Walsh. To date, more than $270,000,000 in gold and silver have been mined in the San Juan area near Silverton, of which $30,000,000 came from Camp Bird. After the first eruption of the Silverton Volcano, one of the craters, eight miles in diameter, collapsed, opening hundreds of fissures in the surrounding rock, which were later filled with rich deposits of gold and silver, some of them five to seven miles long.

Volcanic activity in the ancient Gulf Coastal Plain, an area which now includes Texas, Arkansas and Mississippi, brought diamonds to Arkansas, and formed oil traps in other areas, according to Dr. Hugh D. Miser, of the Geological Survey. Erupting eighty million years ago, the ancient volcanoes were discovered during drilling operations only since 1915. Dr. C. S. Ross, government geologist, reported that New Mexico, a million or so years ago, had a volcanic lake in the Valles Mountains similar to the present Crater Lake in Oregon. This crater, which is the largest explosive crater known, was 17 miles long and 13 miles wide.

SOME FURTHER PAPERS READ AT THE INDIANAPOLIS MEETING OF THE AMERICAN ASSOCIATION

AN immense store of food, rivaling the nation's buried gold reserves in value, is advocated for America as a super-normal granary for use in the emergencies of drought, war or other disaster. Professor R. B. Harvey, of the University of Minnesota, suggested that it would be more logical to have a food reserve that could feed the nation in an emergency than it is to have a gold reserve that has very little practical value; that the government could well spend as much as twelve billions of dollars for plant and animal products that could be held in reserve for decades, not mere years. Since he is one of the leading plant physiologists of the nation and the originator of chemical methods of blanching and ripening fruits and vegetables, his technical knowledge gives the long-time storage suggestion support. "It is best not

to plow under cotton or corn, not to decrease farm production by allowing weeds to grow on arable land and pay for it, but to get the best production of the crop best adapted to the soil and store the excess as a national reserve. We do not know how soon we may be in need of such reserves to release man power. We need to learn how to distribute and conserve maximum production, rather than how to restrict production to a minimum.'' Professor Harvey is confident that physiologists, chemists, pathologists, entomologists and other specialists can work out large scale methods of storage so that food can be kept fresh and edible over long periods. Wheat, for instance, is known to be good to eat after fifty years. Meats, fats and carbohydrates when properly prepared can be stored almost indefinitely.

POSSESSED of more highly skilled automobile drivers than any other age-group, 100,000 drivers between 16 and 20 years of age kill nearly twice as many on the road as the average 100,000 drivers. Accident rates for those below 25 years of age are so high that bringing down that age group's accident rate to the general level would save nearly 8,000 of the nearly 40,000 killed each year on the American highway and street. These challenging figures in support of the contention that certain groups of people are more likely to have accidents than are others were presented to the meeting by Dr. Harry M. Johnson, research associate for the Highway Research Board, Washington. Young men between 19 and 21 years of age are apparently the worst menaces on the highway, Dr. Johnson stated. Middle-aged men, between 46 and 55, may be a bit slow as compared with their younger traveling mates, but they are involved in relatively far fewer accidents. Knowledge of their own skill and consequent willingness to take chances beyond their own capacity to meet were tentatively blamed by the speaker as the factor chiefly responsible for the great proportion of accidents among youthful drivers. ''Some skillful drivers, relying on their agility and alertness, may enter hazardous situations that are a little beyond their ability, whereas less skillful drivers, being aware of their weaknesses, may stay out of them.'' Nearly 30,000 drivers registered for the six years from 1931 to 1936, inclusive, in the state of Connecticut, were the experimental raw material, study of which led Dr. Johnson to these conclusions. Fatal accident figures were compiled from a study of 2,165,241 drivers over a period of five years. His work is being carried out as a joint project of the Highway Research Board and the U. S. Bureau of Public Roads.

AN instrument which increases safety for the mounting thousands of America's airline passengers was one of the leading demonstrations shown at the exhibits of the association. The instrument is the hazeometer from the National Bureau of Standards in Washington. It measures the ''haze,'' or light scattering properties, of the new transparent plastic materials which now are used in the pilot's windshield of high speed transport planes. These plastic windows have replaced glass in airplane cockpits. For one reason they do not rupture when the plane runs into birds. Such accidents are rare, perhaps, but have occurred with enough frequency to warrant safety measures not only for the pilot but also for the safety of his passengers and cargo. The flexibility and strength of these plastics plus their light weight have made them valuable for air transport despite their higher cost than glass. The hazeometer has never before been exhibited, according to officials of the National Bureau of Standards. It was developed by Dr. Gordon M. Kline and Benjamin Axilrod, of the plastics division of the laboratory. While the plastic materials used in the new windshields and windows are strong and light in weight, they are less permanent than glass. They scratch and gradually show surface markings which eventually fog the whole surface. The object of the hazeometer is to test readily the ''fogging'' of the plastics. Until recently the U. S. military services demanded that plastic sheeting should transmit 68 per cent. of white light when tested within 30 days after delivery. Present transparent plastics now in general use transmit about 85 per cent. of the incident light. The hazeometer is a black box about four feet long containing an automobile-lamp light source at one end and a photoelectric cell at the other. By placing the plastic sheet directly in front of the photocell all the light coming through it, scattered and unscattered, can also be measured. The ratio of these two intensities is the measure of the ''haze'' created by the plastic sheet.

MOBILIZING for the war against syphilis must be on a scale like that for a war against a foreign foe. The hugeness of the task was driven home by Surgeon-General Thomas Parran, of the U. S. Public Health Service, in an address before the association. Individuals can not bear the cost of fighting the disease. The lowest price for treatment of syphilis by a private physician is about $300. Over one fourth of syphilis patients who go to physicians to be treated have an income of $1,500 or less. The cost of caring for patients made insane or blind by syphilis is $41,000,000 a year. This huge figure only includes the care of those who are in institutions. Blindness and insanity are only two of the disabling results of untreated syphilis. Total cost of caring for syphilis victims is beyond estimating. The war against syphilis, Dr. Parran made clear, must be financed by states and nations as any other war must be. Unlike other wars, the cost of fighting syphilis can be balanced by the saving of millions of dollars now spent to care for the victims of the disease. Dr. Parran stated that spending public funds for the control of syphilis is a matter of simple economy.

ITEMS

ALMOST all the snow geese in the world are concentrated this winter on a group of low islands off the coast of North Carolina, where rainwater bogs make living conditions favorable for them. The 8,000 or so birds are believed to constitute approximately 98 per cent. of the world's total snow-goose population. They breed in northern Canada during the summer, and fly south for the winter.

REVISION of our maps of the moon may be necessary as a result of the discovery of a series of craters and walled plains, near the edge of its visible disk by H. Percy Wilkins, British astronomer, who reports his new discoveries in the *Journal* of the British Astronomical Association. Occupying twenty degrees of latitude on the southeast edge of the moon, this tangle of walled valleys, craters and high peaks has escaped discovery for many years, chiefly because nobody looked there carefully enough until now. Commenting on Mr. Wilkins's discovery, Dr. Walter Goodacre, acting director of the society, recommended further observations of the moon's edges, which may lead to additional discoveries.

YEARS of drought, like the seven lean years of Joseph's Egypt, are due to grip the Great Basin area of the West, Dr. Ernst Antevs, of the Carnegie Institution of Washington, prophesies in the new scientific publication of the American Geographical Society. Dr. Antevs has made a special study of climatic cycles that swing over long periods of time. He finds that the down curve in far western rainfall has already begun, and states that it is due to reach its climax in a terrific drought about ten years hence. The region for which Dr. Antevs makes his forecast lies between the Wasatch Mountains in the Sierras, comprising about 175,000 square miles in the states of California, Nevada, Utah, Idaho and Oregon. He feels that farmers and stockmen in this region should make long-range plans to meet the situation.

CHEMICALS even more potent than prontosil and sulfanilamide, in overcoming streptococcus and pneumonia infections in mice, are reported by Dr. Sanford M. Rosenthal and Hugo Bauer, of the U. S. National Institute of Health. Human trials have not yet been made of the new chemicals. Prontosil, product of the German dye industry, burst on the medical world a little over a year ago as a spectacular, life-saving remedy for deadly streptococcus infections of mothers following childbirth. Other human ills caused by the streptococcus and by various other bacteria were soon found to yield to prontosil. No sooner had reports of its usefulness in treating disease appeared than chemists in England, France and the United States began analyzing and trying to improve it. The first result of this research was the discovery that the related chemical, sulfanilamide, was as good as prontosil itself. Further research has developed chemicals that are 5 and 6 times as good as sulfanilamide when used to treat mice infected with streptococci. One of these chemicals, the formaldehyde sulfoxylate derivative of sulfanilamide prepared by Dr. Rosenthal and Mr. Bauer, has the advantage of being soluble in water. This should make it easier to use for treatment of infection since ampoules of the solution can be made up in advance and kept ready for use. Heretofore it has been necessary to dissolve the dry material just before using it.

SCIENCE NEWS

Science Service, Washington, D. C.

A NEW TYPE CYCLOTRON

A NEW type cyclotron that promises to yield the most accurate information ever obtained concerning atomic disintegration will be put into operation at Harvard University this summer. It will be the largest of the 20-odd cyclotrons now in use throughout the world.

The major development in the apparatus is a special device that will enable the use of atomic bullets of only one known energy, a procedure that promises to permit far more precise and reliable quantitative measurements of the forces involved in atom-splitting than have heretofore been possible. At its start the Harvard cyclotron is expected to produce atom-smashing projectiles of about eight-million-electron-volt energies. Further development, however, is expected to enable the production of projectiles of much higher energies.

Professor Kenneth T. Bainbridge, Professor Jabez C. Street, Professor Harry R. Mimno and Dr. Roger Hickman are in direct charge of the cyclotron. They have supervised the construction of the apparatus during the past year. They will pay particular attention to the disintegration products and the energies involved in the shattering of the atomic nuclei as part of their study of the fundamental nature of matter. The medical and biological experts of the university will also use the cyclotron in an effort to learn more about the physiological effects of the various products. Preliminary experiments at other universities have indicated that some of these emanations have definitely harmful effects on living tissue, while others may be beneficial, possibly in treating cancer.

To protect experimenters from harmful radiation the entire apparatus when running is surrounded by a protective wall of water in galvanized iron cans, and all operations are controlled from an instrument panel outside this barrier. The hydrogen in the water absorbs dangerous neutrons. Basically the apparatus is similar to other cyclotrons affording the four essentials of atom-splitting: a bullet about the size of an atom, a means of giving it a terrific speed or force, a target composed of the atoms to be exploded and, lastly, a way of studying the wreckage that results to find out just what occurred. Like other cyclotrons, it uses electrically charged particles, or ions, for bullets. In order to build up their speed the ions are loosed in the center of a flat, cylindrical tank between the poles of a giant magnet and then through a combination of tremendous electric and magnetic forces acting in delicate resonance, the projectiles are whirled in a widening spiral, getting a kick of some 50,000 volts each half revolution. The final energy of millions of electron volts achieved by the projectiles is equal to the sum of the energies of the individual kicks. When the bullets reach their top-speed they are tapped off through a glass tube and shot full force at the atomic target. Some miss, but others shatter the nuclei of the target atoms into fragments. These may fly off into space or they may combine with the projectiles to form new elements. Sometimes a projectile lodges in the nucleus, forming an overweight unstable element which in its attempts to get back to normal form shoots off other particles of matter, artificial radioactivity.

Energy-control is obtained by steering the stream of ions through a special magnetic field that attracts, or combs out, all the particles of a single, known energy content. Only these uniform projectiles are used in the bombardment, and thus the energy needed to produce disintegration and the characteristic internal energies of the nuclei will presumably be accurately measurable. Other cyclotron experiments have used the entire stream of ions, the energy content of which may vary considerably. Estimates of the average energy content have been the basis for quantitative measurements under these conditions.

THE SEPARATION OF MOLECULAR SOLUTIONS

A "TREADMILL" for ions is the latest method of separating molecular solutions, according to the annual report of the Biochemical Research Foundation of the Franklin Institute. Dr. Ellice McDonald in his report as director states that such a "treadmill" apparatus is now being imported from Sweden for use at the foundation laboratories.

Dr. McDonald points out that one of the important problems of biochemistry is to determine the number of constituents in a biological solution and separate them for analysis. Where these constituents have the same molecular weight the problem has been a baffling one. The new apparatus being built in the laboratories of Dr. Thé Svedberg effects the separation of such solutions if the molecules in it have different electrical charges on them, even though they have the same molecular weight. An electrical voltage is applied across the solution containing the molecules to be separated. This voltage makes the electrically-charged molecules start to migrate toward the terminals at either end; positively charged molecules move to the negative terminal and negatively charged ones to the positive terminal. The solution is made to flow through the apparatus at exactly the same speed, but in the opposite direction to those molecules which have, say, a single electric charge. Thus these molecules actually seem to stand still in the same way that a man walking on a treadmill can "stand still" in position, even though his legs are moving rapidly. However, a molecule having two electrical charges will "run" faster than the one with a single charge. Thus, this latter molecule will be able to buck the current and eventually reach its goal at the terminal. There it and the millions of other similar molecules which are doing the same thing are drawn off and effectively separated from others having only a single charge. Describing the working of the apparatus, Dr. McDonald said: "Suppose our treadmill is large enough to allow two men to move freely on it. If one of them is capable of walking in the same

direction but slightly faster than the other, they will, in walking, be separated from each other, even though they remain on the treadmill because its motion opposes theirs.''

Another project is a research that seeks to break down the armor-like capsule within which disease bacteria, like those of pneumonia, guard themselves in the body. Dr. J. C. Hoogerheide is seeking some enzyme which will do this. He has been successful in finding bacteria in soil and sewage which accomplish the destruction of the capsule in laboratory tests. The capsule prevents the white cells of the body, the leucocytes, from attacking and killing the disease organism. The capsule guarding the pneumonia bacteria consists of a form of sugar known technically as polysaccharide. This sugar-substance, which the bacteria turn into a fortress, also has another bad effect. Some of it apparently courses through the blood stream of the body and neutralizes the antibodies. Thus treatment by antiserum is also rendered ineffective. If one can obtain an enzyme which will break down the polysaccharides, therefore, it appears that two beneficial results would be obtained. The body does not contain the enzyme necessary for this attack on the polysaccharides. Dr. Hoogerheide has found, however, that certain harmless bacteria from soil and sewage attacks the polysaccharides of the pneumonia germ (Types I, II and III). From pure strains of these soil and sewage bacteria he hopes to prepare the enzyme solutions. The work is so new that actual experiments on animals or man have not yet been tried.

DOUBTS CONCERNING THE NEUTRINO PARTICLE

THE discovery last year of the new ''X'' particle in atomic physics, which has a mass intermediate between that of the electron and the proton or core of the hydrogen atom, has started scientific investigation out of which has grown an interesting and friendly scientific controversy. Scientific men are wondering if the elusive neutrino particle, postulated by theory but yet unfound, will be discovered.

The neutrino—a non-charged particle without mass—has been suggested to explain theoretical aspects of atomic physics where small discrepancies in energy were needed. It was convenient to have neutrinos around in this case so that the mass in transmutation experiments would balance before and after the experiments. Otherwise the physicists would have had to admit that the conservation of energy no longer held true; a long-held and time-tried concept which they hated greatly to discard. When the ''X'' particle was discovered, with a mass 130 times that of the electron and then later with a mass 350 times that of the electron, a preliminary suggestion was that it might consist of an electron bound with a sufficient number of neutrinos to make up the observed mass. This suggestion did not ''take'' well with most physicists, so alternative explanations of the mass of the ''X'' particle were brought forth.

Professor G. E. M. Jauncey, of Washington University, St. Louis, for example, suggested that the apparently variable mass of the ''X'' particle came about because it was created from the energy of a photon of cosmic radiation. Part of this enormous energy, he said, was used to give the impacted electron velocity and energy of motion, and some of it was turned into increased mass of the electron. This explanation needed no neutrinos to give the observed particle its mass. With this idea as a starting point, Professor Jauncey has gone on to suggest that perhaps heavy particles other than the ''X'' particle or so-called heavy electron might be created by a similar process.

In particular, Professor Jauncey set out to find a new explanation for the long-puzzling matter of the continuous beta ray spectrum observed when radioactive elements disintegrate. Beta rays, of course, are another name for electrons. A continuous beta ray spectrum means that the electrons liberated from radioactive elements travel varying distances through the air as they are liberated. They do this apparently for all distances up to some upper limit beyond which they will not go. Because atomic physics has had such good success with quantum theory, which postulates that energies are not liberated or absorbed continuously, but in discrete stages called quanta, it has been most difficult theoretically to figure out how the liberated beta rays showed such a continuous spectrum. Professor Jauncey now explains this well-known observation by suggesting that all the beta rays emitted from a particular radioactive disintegration have the same energy and that their different distances of travel through the air come about because they have different masses and different velocities of liberation. The basic factor is that the product of mass of the beta ray times the velocity must be a constant so that heavy mass goes with low velocity (and short range) and *vice versa*.

With this suggestion of Professor Jauncey's comes the friendly scientific controversy in the *Physical Review*. From the University of North Carolina comes the report of Professor Arthur Ruark and his research assistant, Creighton C. Jones, that experiments patterned after others performed by Dr. F. C. Champion, of the University of Cambridge, England, fail to disclose the experimental findings that should be made if Professor Jauncey is correct in his theories about ''heavy'' particles.

In a letter to the editor of the *Physical Review*, side by side with one from Professor Jauncey, Professor Ruark and Mr. Jones state that for a specific kind of radioactive disintegration—that from Radium E—Professor Jauncey's theory predicts a greater value than is actually observed for the energy of beta ray emission. ''These results,'' they say, ''constitute a definite disproof of the hypothesis of heavy beta-particles.'' Their analysis of the work of Champion and their own experiments ''have no bearing on the possibility that the heavy particles reported in cosmic-ray experiments are electrons of exceptional rest mass.'' What they are questioning is the correctness of applying a hypothesis for cosmic ray energies of a billion and more electron-volts to the lesser degree of energy that exists in radioactive disintegrations.—ROBERT D. POTTER.

HOME FACSIMILE RECEIVERS

THE new compact facsimile receivers which can print whole newspapers in the home while you sleep were demonstrated at the opening session of the National Association of Broadcasters meeting in Washington. The receivers are smaller than most radio sets, except the little midget types, and are the kind which are being placed throughout the country by seven large radio stations launching their experimental facsimile transmission services. The device was developed after ten years of experimentation by Charles J. Young, of the RCA Victor Company, son of Owen D. Young, chairman of the Board of the General Electric Company.

The facsimile receiver-printer is housed in a case less than a foot and a half square. In operation the device is merely plugged into a light socket, tuned to the frequency of the radio transmitter and silently receives and prints text and pictures of typical newspaper layout. The radio "paper" issues from a slot in the front of the machine on white paper 8½ inches wide. The proposed length of each "page" is 12 inches. The simple system offers these pages continuously, one after the other. A more elaborate method cuts each page and drops it into a tray.

In granting experimental licenses for such facsimile transmission the Federal Communications Commission requires that each radio station licensed must install at least 50 receiving units throughout its territory to ascertain public reaction to the transmission, the best type of program material and the technical requirements of both transmitter and receivers.

Transmission of the facsimile radio signals can be on either the longer waves used in present commercial broadcasting or on ultra-short waves. Assignments have been made for the former to be used from 1 A. M. to 6 A. M. when aural broadcasting is now off the air. The ultra-short waves will be used for day or night transmission without conflict with any existing communications.

The seven radio stations which have placed orders for the new equipment include many owned by newspapers. The stations are: KMJ, Fresno, and KFBK, Sacramento, Calif., both owned by the publishers of the *Fresno* and *Sacramento Bee* newspapers; KHQ, Spokane, Wash.; WBEN, owned by the *Buffalo Evening News;* WTMJ, owned by the *Milwaukee Journal;* KGW, owned by the *Portland Oregonian,* and WOR, of the L. Bamberger Company of Newark, N. J.

ITEMS

DR. MARLAND BILLINGS, professor of geology at Harvard University, reports that when the Appalachian Mountains were a hole in the ground, filled with the murky waters of a shallow sea, a series of geologic processes started that led to the formation of potash beds in New Hampshire. He describes the origin of these potash deposits in the *Bulletin* of the Geological Society of America. Starting with deposits in the shallow Devonian Sea, 300,000,000 years ago, when cockroach-like trilobites crawled over the sea floor, Dr. Billings traces the rocks through their various alterations from sea-sediments to changed, heated, compressed masses of metamorphic material. Later, other earth-forces changed the rocks still further, and the potash was introduced from reservoirs of molten rock far below the surface.

AERIAL photography, which already is making possible the swift, accurate mapping of great isolated regions of land, is now finding a new use in the underwater detection of oil-bearing geologic structures. Summarizing aerial photography before the opening sessions of the American Institute of Mining and Metallurgical Engineers, Wayne Loel, consulting geologist, said that off-shore oil structures have been observed by aerial photography. The method is not yet in general use, but its possibilities are intriguing. The secret of the work is that the rocks of the sea or lake floor be not obscured by sediment. When the bottom is sandy the position of reefs can be noted by the kelp growing on them. To get the true outline of the reefs it is necessary to photograph on days when there is no wind or ocean swell to disturb the kelp, which then rises vertically from its roots on the reef.

How a sea that dried up more than 500,000,000 years ago in what is now northern Michigan and Wisconsin became a great iron-producing area was explained by Dr. Gordon I. Atwater, Skelly Oil Company geologist, describing his findings in the *Bulletin* of the Geological Society of America. Spending two seasons in the field, studying the puzzling slate formations that separate the iron ores from the copper ores, Dr. Atwater found that after the iron-bearing rocks were deposited in this ancient sea, the sea floor was bowed up, and the higher parts eroded away. During this time, the waters worked on the iron, redepositing it in masses that are now mines. Later, the rocks flattened again, and two miles of sediments were deposited atop the iron-bearing rocks. Over all of this, copper-bearing lavas five miles thick poured out at a later time, forming the rich Calumet-Hecla copper deposits of Michigan. By showing that the Tyler formation, a slate bed on one side of the iron deposits, was the same as the Copps formation, a slate bed on the opposite side, Dr. Atwater was able to trace the bowing up of the ancient sea floor, and solve the puzzle of the iron and copper deposits made half a billion years ago.

DESPITE new and better physical understanding of the nature of weather analysis, forecasting will require for a long time to come the services of an experienced weather forecaster, according to Edgar W. Woolard, of the U. S. Weather Bureau. Writing in the current issue of *The Journal of Applied Physics,* Mr. Woolard says: "For a long time to come . . . weather forecasting must continue to be a combination of physical reasoning with methods based on accumulated practical experience with synoptic charts. We can not yet, and perhaps may never, safely do without the empirical judgment of the experienced forecaster." The new methods of studying weather, air mass analysis and so on, will, however, add to the precision of forecasting. The new methods, he added, "will, moreover, have the distinct advantage of making weather forecasting less of an esoteric art, irrespective of the extent to which they may effect actual improvements over the results already obtainable by empirical practices."

SCIENCE NEWS

Science Service, Washington, D. C.

THE TENTH SATELLITE OF SATURN

SATURN may really have ten satellites, according to a report in the British journal, *Nature*. John Miller, of London, a member of the British Astronomical Association, suggests that a tenth satellite may be found in the region between the present eighth and ninth satellites of brilliant Saturn. The orbit of the tenth satellite, if it exists, should be about 2,000,000 miles farther out from the one known as Iapetus and 4,000,000 miles inside the orbit of the outermost satellite, Phoebe. The 6,000,000 gap in space between Iapetus and Phoebe has long been of interest to astronomers. If the approximate placing of the satellites follows the astronomical rule known as Bode's law, then satellite 10 should be found at the distance Mr. Miller suggests.

Bode's law is a long-known empirical rule which has no physical explanation. The so-called law states that there is a regular progressive increase in the mean distances of the planets from the sun. The law holds good for all the planets except Mercury and Neptune and can not be regarded as merely coincidental truth. With the planets, if one takes the distance of Mercury's orbit from the sun as a starting point and calls the distance from Mercury's orbit to the orbit of Venus as 3, then the distance of the other planetary orbits from that of Mercury turn out to be roughly in the geometrical progression 6, 12, 24, etc. This same general relationship seems to apply to satellites. In his report to *Nature*, Mr. Miller sets up two tables of values—one for the observed distance in miles between the orbits of the respective known satellites and another giving the distances based on geometrical progression. In most cases the agreement for the nine known satellites is fairly good. There is only one large discrepancy. That is the blank hole in the table which Mr. Miller suggests is the spot for the yet undiscovered satellite. In 1905 the late Professor W. H. Pickering reported a faint satellite of Saturn which has never been confirmed. Mr. Miller suggests that perhaps the tenth satellite is the missing object reported 33 years ago by Pickering.

PROSPECTING FOR OIL

ACCORDING to a report by Dr. M. M. Leighton, Illinois State Geologist, oil wells in places regarded as impossible before 1930, located by systematic use of modern scientific prospecting methods, have led to the discovery of eight new oil pools in southern Illinois and the increase of the known oil reserves of the state by at least 100,000,000 barrels.

Found as a result of a planned search, these new oil pools are in an area regarded as barren before 1930. Realizing, as a result of intensive field work, that there should be domes within the great Illinois Basin, the state geologist's forces, with some private companies, began an intensive search for such oil traps, located a number of probable traps by geophysical methods, and proved the correctness of their findings by bringing in producing wells on eight of them. Modern prospecting methods have cut drilling losses more than fifty per cent. Wildcat drilling (drilling in areas where there are no producing wells) resulted in bringing in oil only once in every ten attempts during 1937 when the well was sunk only on a "hunch." When the suspected area was first gone over by geologists with modern methods, the score was one producing well for every four wildcat drillings.

With Illinois oil production already tripled by these new fields, 150 or more geologists working for oil companies are now at work endeavoring to locate new oil pools. Increasing the recovery of old oil fields by secondary methods is now being tried in Illinois, following the general ideas used in the Bradford Oil Field of Pennsylvania. Water poured into some wells revives the others near-by, increasing the ultimate production considerably. By this method, Dr. Leighton says, Illinois oil fields may yet produce as much oil as has already been pumped from them.

SOIL RESEARCH

IN an attack on the problem of soil erosion on the western plains, two wind tunnels, one in the laboratory and the other out in the field, are being used at the Soil Research Laboratory of the Dominion of Canada Experimental Station at Swift Current, Saskatchewan.

Patterned after wind tunnels used by aeronautical engineers the world over, two machines have been set to work to tell erosion specialists exactly how erosion takes place, according to J. L. Doughty, senior soil specialist at the station.

Investigators will shortly begin measuring the wind velocity necessary to make particular types of soil fly away with the wind. By means of the pair of tunnels, they also expect to study the nature of the drift and of sedimentation. The larger of the two units, a 20-foot-long tunnel in three sections can be moved to different fields for actual tests outside the laboratory. The smaller unit, five feet long, is for laboratory use. Airplane propellers powered by variable speed motors provide the air blast to shake loose top-soil so that its behavior can be measured. The engine for the portable unit is mounted on a truck.

The first section of the portable unit consists of a box with vertical panels to eliminate turbulence and thus to secure a steady wind stream. The second is closed on the top and sides, but is open on the bottom so that the air blast can rip up the soil. The third portion, at the end away from the propeller, is closed on the bottom and open on the top. It is protected by screens to slow down the air stream and permit settling of the dust particles to begin.

"This machine," Mr. Doughty writes, "is taken directly into the field, and the tunnel set up over an area of soil which has not been disturbed since the last cultural treatment. The exposed test area is then subjected to an air blast of known velocity for a definite period of

time. If drifting does not occur, the velocity will be increased and kept constant for another period. By this means, the velocity required to start the particles moving and the amount of soil moved during a definite time with a known velocity of wind are determined."

Data resulting from the study, it is believed, will constitute one of the first exact determinations of the conditions necessary for rapid wind erosion. Wind erosion, in addition to weathering from rain waters, is a serious menace to the entire Great Plains area that stretches from the Rio Grande and the southern states north to ground too frozen to permit profitable farming.

Different soils, with different types of cultural treatment (on which different crops have been grown) will be studied, in order to determine "the effect of different cultural treatments on the susceptibility of a soil to drifting."

A still larger wind tunnel is to be built, Mr. Doughty adds. "Present plans call for the construction of a tunnel 30 or 40 feet long, which would add materially to the data that could be obtained in a study of soil drifting problems."

MALARIA MOSQUITOES AND WILDLIFE CONSERVATION

DR. L. L. WILLIAMS, JR., of the U. S. Public Health Service, speaking before the Third Annual North American Wildlife Conference, recently held in Baltimore, pointed out that creators of refuges for ducks and other forms of aquatic wildlife should take heed lest they raise malaria mosquitoes as well as ducks. Much of the Midwest was once malaria country. In the course of settlement and development of agriculture the old breeding waters of the mosquitoes were drained. Now the program for the restoration of American wildlife calls for the development of many new ponds and marshes where wildfowl, fish and other water-using creatures may feed and breed.

If these refuges are near human habitations, especially if they are in areas used for camping or resort purposes, a very few human malaria carriers might equip the "right" kind of mosquitoes for serious trouble-making. He added that something of this kind has already occurred in several places. Dr. Williams's discussion was one contribution in a panel discussion of the whole mosquito-control problem, in which his co-participants were Clarence Cottam, of the U. S. Biological Survey; Dr. F. C. Bishopp, of the U. S. Bureau of Entomology and Plant Quarantine, and William Vogt, of the National Association of Audubon Societies. General discussion from the floor followed, and was at times quite vigorous. The principal bone of contention was over the question, to drain or not to drain. Nobody had a good word to say for the mosquito, but many of the friends of wildlife feel that drainage as practiced at present is destroying great areas that have in the past been dependable providers of sport and food.

Mr. Cottam pointed out that in the coastal area from New Hampshire to Maryland 30,000 miles of drainage ditch have been dug, with an additional 36,000 miles in the South. Much of this, he believed, was unnecessary. Unrestricted drainage not only removes the water that wildfowl like and fish must have; it also upsets the whole biological balance. As the soil dries out the marsh grasses and the other good food plants perish, to be replaced with weed species that will not support wildlife. Small forms of lower animal life, used as food by wildfowl, also disappear. Use of oil to smother mosquito larvae came in for condemnation second only to that bestowed on excessive drainage. It was pointed out that equally effective mosquito control can be achieved by spreading Paris green, pyrethrum powder and other insecticides. In rebuttal to this it was urged that for many large areas where control is needed these methods are too costly. Differences do not appear to be beyond reconciliation, the floor discussions showed. A number of speakers, themselves mosquito-control workers and field biologists, pointed out methods used in particular localities, where study of local ecological conditions made possible the suppression of the mosquitoes and yet left a refuge for ducks.

FRATERNAL TWINS

PROFESSOR WILLIAM WALTER GREULICH, of the department of anatomy and the Adolescent Study Unit at Yale University, presents a study in the forthcoming issue of the *Journal* of the American Medical Association, of the six pairs of fraternal twins in a Connecticut family. He has also looked into the family history of the twins' parents, Mr. and Mrs. H. F., of Putnam, Conn. Only on the father's side can a record of previous multiple births be found. The father's father had triplets by his second wife.

The wide-spread belief that twinning tends to run in families is supported by evidence here and abroad, and twin births everywhere seem to appear just as frequently on the father's side as on the mother's. Now this disturbing fact can not be reconciled with the accepted theory of the genesis of fraternal twins. Fraternal twins, as distinguished from monozygotic twins (those of the same sex and physical characteristics), are produced, it is usually assumed, by the fertilization of two ova derived from separate follicles either from the same or from different ovaries. Such double ovulations are exceptional and are generally regarded as the result of some upset in function of the ovulatory mechanism. The control of this would naturally be with the mother and could not possibly be influenced by the father.

Professor Greulich appeals to surgeons and pathologists to make observations during operations and postmortems on pregnant women that will help find a satisfactory explanation of this phenomenon. The most reasonable explanation, in his opinion, was advanced twenty years ago by Dr. C. H. Danforth and recently by Dr. F. Curtius of Germany. According to this hypothesis, the sperm of some men causes the tubal ovum to form two cells, both of which are susceptible of being fertilized, each, of course, by a different sperm. Such fertilization would result in the production of twins who had the same heredity from the mother's side but different paternal heredity. Such twins might be of like or of unlike sex

and would presumably be intermediate between identical and ordinary double-egg twins in the degree of resemblance that they would bear to each other. The Connecticut family had its sixth pair of twins last June 12. The mother was 35 and the father 57 when they were born. Of the first pair of twins the boy died, but all others are living. Two pairs are of the same sex but do not resemble each other closely.

VITAMIN K

VITAMIN K, from fish meal, together with bile salts, is now being used in the treatment of jaundice. A preliminary report of encouraging results at the Mayo Clinic has just been made. The jaundice is the kind known as obstructive jaundice because it is due to obstruction of the flow of bile. The new vitamin treatment does not help the jaundice, but controls the bleeding which is a dangerous feature of the disease. Treatment of the jaundice itself is operation to remove the obstruction to the bile flow, but this is not always possible because of the tendency to uncontrollable bleeding. The new treatment has been used in 18 cases, Drs. H. R. Butt, A. M. Snell and A. E. Osterberg report. In certain cases, they state, this treatment "probably has prevented hemorrhage or has had a definite inhibitory effect on actual bleeding. We realize," they add, "that much more data must be collected before any definite conclusions may be drawn and that the whole problem is one of extraordinary complexity." The complexity arises from the fact that in spite of much research over many years by many individuals, the exact mechanism which normally prevents hemorrhage by making blood clot when it is shed is still not too well understood. The results with the treatment so far encourage the Mayo workers to believe that prevention and control of the bleeding tendency of the jaundiced patient may be attained in the "not too distant future."

Vitamin K is a relatively new vitamin found in hog liver oil, cabbage, spinach, tomatoes, alfalfa and various other natural sources. Dried alfalfa meal was at first used in the treatment at the Mayo Clinic, but as the patients could not tolerate this for long, the vitamin is now being obtained from fish meal. It is given together with bile or bile salts. Lack of vitamin K in the diet of chicks and certain other animals causes hemorrhagic or bleeding disease. In human patients suffering from obstructive jaundice, the bleeding apparently occurs because damage to the liver caused by obstruction to the flow of bile from the gall bladder makes it impossible for the patient to utilize the vitamin K in his food.

ITEMS

ROCKS of a geological formation half a billion years old, scattered from Alabama to Labrador, have been identified as belonging to the same system by fossils they contain, of two genera of trilobites, Wanneria and Olenellus, long since extinct. The rocks, of early Cambrian date, have also been shown to be similar to others in Scotland and Greenland. The investigations were carried on by Dr. C. E. Resser, of the U. S. National Museum, and Dr. B. F. Howell, of Princeton University. Their report is given in the *Bulletin* of the Geological Society of America.

FOUR distinct types of avalanche menace the skier, reports Donald McBride, mountaineer, writing in *Trail and Timberline*, the official journal of the Colorado Mountain Club. Of the four types, wet snow, dry snow, ice and snow-slab avalanches, the latter is the most dangerous to skiers in the Colorado Rockies. Recognizable by the great slabs of wind-deposited snow that form its débris, the snow-slab avalanche occurs when the weak snow under the slab melts away, leaving the strong slabs without support. These crash to the valley floor, sweeping all before them. Often the weight of a skier, crossing the "triggered" slabs, is enough to start a dangerous avalanche.

GUAYULE, the rubber-yielding shrub of the arid lands in California and adjacent parts of Mexico, will be planted in quantity during 1938 in the southern part of the Italian peninsula, in Sicily, and in the trans-Mediterranean province of Cyrenaica. This is part of Italy's effort toward economic self-sufficiency, and in particular it is hoped will provide an emergency supply of rubber in case of war.

A HELIUM refinery, to remove impurities from the helium gas that will float the *LZ–130* back and forth across the Atlantic, will be erected near Frankfort, home port for the sister ship of the *Hindenburg*. Low temperatures will condense and settle out gaseous impurities from the helium gas after use so as to fit it for further use and to conserve the precious gas, which must be purchased in the United States. Germany only recently purchased several million cubic feet of helium.

NOT one out of a hundred of the drivers coming into traffic court has learned how to drive his car with competence, tactfulness and care for the other fellow, Dr. Lowell S. Selling, director of the Psychopathic Clinic of the Recorder's Court, Detroit, reported to the Twenty-fourth Annual Highway Conference at the University of Michigan. His conclusion is based on an examination of hundreds of drivers in the Psychopathic Clinic. Many of the drivers involved in traffic offenses are insane, Dr. Selling has found. Many are dangerously feebleminded. Many are illiterate. And many are relatively normal, but their thinking processes about driving are bad. Ordinary psychological tests of such traits as reaction time, vision, color vision and hearing can not weed out the accident-prone drivers, Dr. Selling has found. And drivers with defects in some of these traits may be perfectly safe drivers, provided they are aware of their weaknesses and have the proper attitude. Deaf people, for example, had a better accident record than those who could hear, and in addition most motorists are driving deaf when their windows are up.

SCIENCE NEWS

Science Service, Washington, D. C.

THE STRUCTURE OF SOLIDS

THE new theories of atomic physics—quantum and wave mechanics—are clarifying knowledge of the structure of solids and thus bringing these seemingly "impractical" playthings of the mathematical physicist into the realm of material objects which one can see and touch; objects which an engineer or layman could class as "practical."

Speaking in New York before a joint meeting of the Optical Society of America and the American Physical Society, Professor L. A. DuBridge, of the University of Rochester, described the newest advances of the attack of science on the secrets of matter. He emphasized that the nature of the structure of solids like metal crystals, or glass, or insulators, is only in its beginnings, but already the quantum and wave mechanics has interpreted —from a single starting point—many properties for which each formerly needed its own little separate theory to account. In particular, the old theory of the conduction of electricity through metals has been revised and physicists no longer picture a metal bar as containing myriads of so-called "free" electrons which could move freely about within the metal and conduct the current.

The central idea of the new picture is that a crystalline solid, like a metal, may be regarded as a single giant molecule. For a crystal of ordinary size this "molecule" will contain in the neighborhood of a million, million, million, million atoms. Or the figure 1, followed by 23 ciphers. All these millions upon millions of atoms packed into a regular array in a single crystal produce effects quite different than if they acted individually as they would in a gas. The little energy levels of the atoms between which electrons jump to absorb or release energy are no longer peculiar to the atoms singly. There are energy levels for the whole crystal. And it is the movements of electrons into these energy levels of the crystal which determine many of the properties of crystals. Crystals like those of sodium, potassium or silver are pictured by the new theory as consisting of electrons occupying the bottom of two broad bands or zones of energy. If the metals are cooled to absolute zero all the electrons are in the bottom compartment of what might be called an energy "basement."

By old theories it was predicted that solids cooled to absolute zero would possess no energy because the energy of motion of the electrons would be stopped. And without motion there was no energy. By the new theory it is predicted that even at absolute zero the electrons have motions and energies from 50 to 100 times greater than it was formerly believed they possessed at a temperature of 1,000 degrees. When an electric field is applied to metals of this group the outer electrons (or those at the top of the energy basement) will move up to the next lowest unoccupied energy levels. They move with the electric field and give rise to current. If vacant energy levels exist, to which the electrons can jump, then the metal is called a good conductor of electricity. Sodium, potassium and silver are notably good electrical conductors. If the electrons have no vacant levels to which they can go when an electric field is applied because these levels are already occupied, there is no current produced and the solid is known as a poor conductor, or a good insulator. Thus the strange situation may arise where one solid may have twice as many "free' electrons as another and yet be an insulator, while the latter is a good conductor; the reason being that the "free" electrons have no place to go.

"The new theories," said Dr. DuBridge, "offer, for the first time, a picture of why one substance is a good insulator or a good conductor. The necessary condition for conduction is that there shall be unfilled but allowed levels immediately adjacent to the occupied levels." The new theories also offer explanations of heat conduction in solids and predictions of the binding forces in crystals. Moreover, the optical properties of solids—like the photoelectric effect on which all photocell operation is based—are taking on a new understanding through analysis by the new theories. The magnetic properties of crystals are also being studied and, said Dr. DuBridge, "for the first time a satisfactory theory of ferromagnetism is being developed."

PHOTOGRAPHIC ANALYSIS OF ATOMIC COLLISIONS

BEFORE the New York meeting of the American Physical Society Professor Arthur E. Ruark, of the University of North Carolina, described a new viewing mechanism which projects in three dimensions the pictures of tracks of atomic particles taken with Wilson cloud chamber apparatus.

With almost automatic precision the cloud chamber takes literally thousands of pictures of atomic collisions. The difficulty with research in the field of subatomic particles comes not in taking the pictures but in analyzing them and correctly interpreting what is shown. Special cameras taking two views at right angles to one another give a three-dimensional picture of the tiny tracks which the invisible speeding particles cause. But to handle each separate picture of thousands is a tedious time-consuming job which means weeks and months of study and delays publication of results.

There was a time when slowness was synonymous with scientific research, but in the field of atom-smashing hundreds of laboratories throughout the world are working furiously in a literally virgin field of study. Giant cyclotron apparatus for smashing atoms, in some cases, is being operated on two eight-hour shifts a day and the whole field is one of intense activity. At one period investigators were even wiring their results into the technical journals to insure priority rights in their discovery claims.

The new North Carolina apparatus takes its pictures on rolls of film with a miniature type camera. When

developed the film is put back in the camera and the two images projected on suitable viewing screens. Special accurate, circular gradations permit the viewing screen to be turned vertically and horizontally so that the direction, in space, of the tracks can be quickly determined. As soon as a particular picture has been analyzed, the switch is thrown and the next picture pops into view. Speed, ease and several technical special uses make the new device highly valuable to an important field of science.

OTHER PAPERS READ AT THE NEW YORK MEETING OF PHYSICISTS

PROFESSOR VLADIMIR KARAPETOFF, of Cornell University, showed a compact little device which can be set up on a table of elements to show the results of an impact upon any element or isotope by any one of several different kinds of sub-atomic "bullets" used in experiment. By properly reading the scale the theoretically possible resulting products of this atom smashing and the ejected particles that should come off, can be read. The work of forecasting disintegrations and transmutations has become increasingly complex, and yet more and more scientists and amateurs are becoming interested in it, said Professor Karapetoff. Nearly all the stable elements have been made radioactive by bombardment experiments and the number of possible forms of matter now runs into the hundreds instead of the simple 92 forms found in the old tables of the chemical elements. Moreover, the number of possible kinds of bombarding particles has been increased to nine, in Professor Karapetoff's scale, so that the varieties of the various impacts which can occur set up a great mass of data. Professor Karapetoff's new scale brings order out of this drudgery and forms a convenient tool for the experimental and theoretical physicist in his nuclear research. The scale gives all the theoretically possible transmutations of elements; quantum-mechanical computations and the experiment are necessary to decide on those which can actually take place.

DR. S. E. FORBUSH, of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, reported that a study of data on cosmic ray intensities, as they varied with sidereal, or star, time through the 24 hours of the day showed that the tiny variations can not be real. Two years ago, Dr. Arthur H. Compton, of the University of Chicago, suggested that if cosmic rays did originate outside the earth's galaxy of stars then, because of the galactic rotation, there should be times when the earth was moving "against the current" of the oncoming cosmic ray stream, and other times when it was moving "with the stream." This movement with, or against, the possible cosmic ray "current" would produce changes in cosmic ray intensity varying with sidereal time. Since this suggestion was made, careful checks have been kept on cosmic ray intensities in Europe, South America and the United States. Data for 595 days are now at hand and were analyzed by Dr. Forbush as the basis of his report. Using less powerful methods of statistical analysis other investigators have announced "real" variations of about .05 (five one-hundredths) per cent. Dr. Forbush, with his more penetrating methods, now announces that the variations suspected can not be considered real on the basis of the present amount of data. More data, now being accumulated, may answer the point at some future time and give a final check to the Compton theory of the origin of cosmic rays.

DR. DAVID I. MACHT, of Hynson, Westcott and Dunning, Inc., Baltimore, stated that pharmacological studies are seeking to learn the causes of x-ray sickness which not infrequently occurs in patients undergoing x-ray therapy. Studies show that the blood of irradiated animals contains toxic substances which appear from 12 to 24 hours after the treatment and do not disappear for several days. The amount of toxin varies with the region of the body irradiated with the x-rays. Studies of brain tissue in animals irradiated with x-rays shows that there is some impairment of enzymatic activity, said Dr. Macht. Recovery comes if the dosage is not excessive. Clinical studies on human blood are now in progress. A search is also being made for drugs which may counteract the toxicity created by x-rays.

THE last steps in the explanation of the extremely slow "death" of the longest-lived beta-radioactive element known, were announced. The puzzling element was the rubidium isotope 87, which requires 100,000,000,000 years for its radium-like activity to decrease by half. The several varieties of radium itself have "lives" of only a few minutes to at most 300,000 years. Reporting to the meeting of the American Physical Society, Dr. E. J. Konopinski and Professor H. A. Bethe, of Cornell University, described the calculations which confirmed an ingenious explanation of rubidium's longevity. Recent experiments by Kopfermann in Europe have determined the spin of the final decay product of the radioactive disintegration. This spin turned out to be considerably different for the final product than for the radioactive parent from which it originated. Professor Bethe and Dr. Konopinski showed the feasibility of the explanation that the extremely long life comes about because the decay process is slowed up by the difficulty the atom has in changing its gyroscopic spin. In analogy, at least, the tiny spinning gyroscope within the atom slows up the decay in the same way that a gyroscope on a boat slows up the roll of the ship in rough water and thus makes a smoother ride.

To maintain the existing radiation pouring out from the sun it is necessary that each one of the trillions upon trillions of protons and neutrons contained in it must give out a photon of light every 20,000 years. Calculations of the sun's energy and estimates of its radiation production were presented by Dr. Arthur E. Haas, mathematical physicist, of the University of Notre Dame. Every second the sun liberates photons represented by an enormous number consisting of 2×10^{45} or the figure 2 followed by 45 ciphers, photons a second. The total number of particles in the sun (the protons and neutrons)

Dr. Haas estimates as consisting of 1.2×10^{57} particles, or a number represented by 12 followed by 56 ciphers. It takes the sun about 20,000 years to liberate a number of photons equal to the number of particles it contains. "We must therefore assume," said Dr. Haas, "that each primordial particle contained in the sun experiences, at least in intervals of about 20,000 years, some reaction leading to the emission of a photon, or we must assume that extremely 'hard' primary photons produced in the interior of the sun split into a variety of softer photons on the way to the surface of the sun, or perhaps we must combine both assumptions."

COSMIC RAYS may be the most piercing and powerful of all radiation, but one modern steam generating plant develops about the same amount of energy as do all the cosmic rays incident on the surface of the earth. Dr. Thomas H. Johnson, of the Bartol Research Foundation of the Franklin Institute, estimated that the total cosmic ray energy striking the earth comes out to be about a million kilowatts. This is the same energy rating as the new steam generator plants of the South Philadelphia Electric Utility Company. The total number of rays striking the earth per second, said Dr. Johnson, is 8×10^{27}. This makes the cosmic ray current to the earth .13 amperes. The average energy per ray is about 160,000,000,000 electron volts.—ROBERT D. POTTER.

NEW OIL DISCOVERIES

FOR the first time in a decade the 1937 discovery of new oil reserves has exceeded annual production in the rich California petroleum fields, according to a report to the meeting of the American Institute of Mining and Metallurgical Engineers by V. H. Wilhelm, chief petroleum engineer of The Texas Company (California), Los Angeles, Calif. The major discovery of the year was the field in San Joaquin Valley where a well came in at 11,302 feet deep with a production of 1,400 barrels of oil daily. During the year an estimated 238,000,000 barrels of oil were withdrawn from reserves, but new discoveries will amount to almost twice this amount. In South Louisiana 14 new oil fields were discovered during 1937. In the main, production is coming from the 10,000 foot levels in Miocene sands. In Mississippi drilling in the state's two fields continued to decline and 1938 is expected to be a year of great activity in the search for new reserves. About 20 geophysical prospecting parties worked in Mississippi during 1937 and located salt domes and other types of oil-bearing structures which will, in 1938, be definitely tested by drilling operations. In Missouri the state witnessed the best year in its history in the discovery of gas wells. The 49 completed gas wells showed an initial flow each averaging 1,000,000 cubic feet per day. Eight of these wells also showed oil. In the Texas Panhandle region 663 oil wells were drilled in 1937 having a daily initial production of 322,332 barrels. The total proved production area in the state is now 118,050 acres or the equivalent of 184 square miles. One hundred and sixty-eight gas wells were also drilled with a combined opening flow of over six billion cubic feet of gas. Forty-six gasoline-extraction plants in the state during the year processed 273,318,108 gallons of gasoline from gas.

ITEMS

LABYRINTHIC passages comprising a cave about one fourth as large as Carlsbad Cavern, discovered only a few days ago, were explored immediately by government rangers. The entrance is nine miles from Carlsbad, on government land, outside the Carlsbad Cavern National Park, but inside the withdrawn area. The newly-discovered cavern is "quite dingy, containing only three sizable formations," reports Colonel Thomas Bowles, superintendent of Carlsbad Caverns. The National Park Service declined to comment on the geologically possible underground connection between these caves and Carlsbad Cavern.

DR. R. A. FOSHAG, curator of minerals at the National Museum, points out that "recent diamond finds at Cherokee Flats, near Camino, Calif., do not justify any rush to the area in search of easily-gotten glittering stones." One diamond from the Cherokee Flats region is received at the museum every three or four years. Perhaps two hundred diamonds have been found in California since the gold rush days, the largest reported being about seven carats. The Cherokee Flats diamonds are perfectly good stones, their rarity, rather than any defect in them, making the placer gold deposits unprofitable as diamond mines.

GREEN fodder for winter feeding to livestock is made from seeds in only six days in a device of British invention now being demonstrated at the New York Museum of Science and Industry at Rockefeller Center, New York City. The "fodder factory" consists of an insulated cabinet containing a series of perforated trays. In these are placed quantities of grain, legumes, or other seeds, after soaking for 24 hours. The trays are kept at a constant temperature, and watered from the top. At the end of six days, when the sprouts have reached a height of six inches, the entire contents of the trays—sprouts, soft seeds, and roots—are fed to the livestock, which relish the succulent fodder. A larger cabinet than the one on display here is being tried out on a working scale at a large dairy farm in Connecticut. The "fodder factory" is an invention of Captain H. H. B. Lund, of England.

STRENUOUS athletic activities have no bad effect on the heart, in the opinion of Dr. E. L. Cooper, Dr. J. O'Sullivan and E. Hughes, of the University of Sydney, Australia. They examined a series of oarsmen from universities and colleges before going into training, after training and before and after racing. They investigated the heart by means of the measurements of the pulse, x-ray photographs and by means of the electrocardiograph. In addition, observations on blood pressure measurements and body temperature were made. The investigation was also extended to men playing squash rackets and pedalling a fixed bicycle against a brake. They could find no evidence of any permanent change in the heart as a result of training for and taking part in athletic sports. Their final conclusions were that even extreme physical effort on the part of an athlete such as the final dozen at the end of an exhausting two-mile rowing race does not result in damage to the heart.

SCIENCE NEWS

Science Service, Washington, D. C.

HEAVY ELECTRONS

THE name of Professor Arthur H. Compton, physicist of the University of Chicago, now appears in the friendly controversy over whether "heavy" electrons can exist in the radiation emitted from the radioactive element known as radium E.

In the current issue of the *Physical Review*, Professor Compton analyzes the experimental results obtained by Professor G. E. M. Jauncey, of Washington University, St. Louis. Professor Jauncey has interpreted the particular beta ray (electron) images he obtained on his photographic plates as indicating electrons having a mass three times as great as the mass of an ordinary electron. Thus these special electrons have been called "heavy." By calculations based on the size and shape of the apparatus of Professor Jauncey, Professor Compton reports that a single spurious reflection of the beta rays off one surface of the apparatus could explain the particular images whose appearance is explained by saying "heavy" electrons produced them. If such reflections occur, ordinary electrons and not "heavy" ones could produce the results observed.

The whole subject of "heavy" particles from radium E has been the topic of numerous technical communications to the magazine for some months, by many scientific men. The subject has been in the news of physical science since the "heavy," or X, particle was detected in cosmic radiation by Drs. Carl Anderson and Seth Neddermeyer more than a year ago. No one has seriously challenged the idea that in the enormous energy range found in cosmic rays there may exist "heavy" electrons having masses hundreds of times the normal. But there are many physicists who can find many reasons for not accepting, at the present time, this same idea for particles emitted in the lower energy range of radioactive radiation. Definite conclusions, for or against the existence of low energy "heavy" electrons, will come when the various investigators agree on experimental evidence; a point which has not yet been reached in the present early stage of the controversy.

THE MAGNETISM OF THE EARTH

DR. M. A. TUVE, of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, in a recent address, stated that a clue or perhaps a new and unknown principle of physics which can explain the large magnetism of the earth and the far vaster magnetism of the sun is still being sought.

For ten years the department, under the leadership of Dr. J. A. Fleming, has searched for the answer to the baffling question whose solution would make clearer the rôle played by the earth's magnetic field in man's daily life; a rôle which affects radio, wire communication, cosmic ray intensity, the amount of ultra-violet light striking the earth and many other factors in man's existence. On their ten-year research march toward this goal Dr. Tuve and his colleagues, Dr. L. R. Hafstad and Dr. N. P. Heydenburg, of the department, and Professor Gregory Breit, of the University of Wisconsin, have uncovered new and important findings, but most fundamental of all was the detection and measurement of the enormous force within the cores of atoms that binds their parts together and prevents the universe from consisting of nothing but the nuclei of the simplest atom, hydrogen. Thus the program which began and still seeks explanations of earth and solar magnetism has led into the hearts of the tiniest things in the universe. But neither the tremendous force there discovered nor any other fact of modern physics has yet led to a clue which might explain the permanent magnetism of the earth.

To explain these large magnetic fields in the sun and earth, it appears that either some new complexity will have to be introduced into the fundamental concepts of physics or that some new and yet unfound principle of physics will have to be discovered.

Dr. Tuve indicated that the first view seemed to be the more probable. However, some unknown atomic force occurring at the extremely high pressures within the earth and the sun may be the cause of the large magnetic fields. The nuclei between which the new force of attraction has been found to exist are so minute that if one of them were enlarged to a diameter of half an inch the fingers and thumbs of the investigators on the same scale would be approximately 10,000,000 miles long.

RENTSCHLERIZATION

A "MICROBE DEATH RAY" to keep your food from spoiling, your wounds from getting infected and your lips from being soiled with other people's germs traveling on glasses and table ware, was demonstrated to the American Institute in New York on March 3.

This development may also add a new word to American vocabularies—"rentschlerization." It is derived from the name of the man who developed the ray, Dr. Harvey C. Rentschler, director of research in the lamp division of the Westinghouse Electric and Manufacturing Company. "Rentschlerization" will rank with "pasteurization," it is claimed. "Rentschlerization" is the process of killing disease germs by exposing them to a single ultra-violet ray with a wave-length of 2,537 Ångstrom units. The ray is harmless to humans. Associated with Dr. Rentschler in developing the microbe death ray was Dr. Robert F. James, Westinghouse biophysicist.

The ray, released from slender tubes called sterilamps, made its surgical début in the operating room of Duke University Hospital under the direction of Dr. Deryl Hart, surgeon-in-chief. Dr. Hart described this use of the ray at the meeting. Infections after surgical operations do sometimes occur even with the most careful, germ-free surgical technic, because before the development of the new microbe death ray it was impossible to keep the air of an operating room germ-free. Dr. Hart reports that since installation of the ray tubes, post-operative infections have practically disappeared from his operating

room. Furthermore, patients had much lower temperature curves following operations in which these tubes were used to keep germs out of the air over the operating table. As a result of Dr. Hart's successful experiments, which have been in progress for nearly two years, sterilamps have been installed at the Mayo Clinic, the New York Medical Center, the Perth Amboy, N. J., Hospital, and elsewhere.

The search for the ray started from the angle of food preservation. Cooking is one form of sterilizing food, and certain chemicals will preserve foods. So do refrigeration and pasteurization. None of these methods is universally practicable, it was pointed out at the meeting. Neither chemicals nor heat, for example, can be satisfactorily applied to the preservation of such perishable foods as meat and often, even in very cold refrigerators, meat is attacked by molds. Now the butcher can install sterilamps in his refrigerator and even in his display cases and keep his meat protected both from germs and from loss of water and flavor due to the low temperatures previously needed to preserve the meat. Keeping glasses and tableware germ-free in restaurants is not only a question of washing them clean and sterilizing them but of protecting them from germs in the air that can reach clean dishes stacked on shelves. Sterilamps seem to be the ideal solution to this important sanitary problem, since they are inexpensive and can be easily installed.—JANE STAFFORD.

BIOELECTRIC DIFFERENCES AND CANCER DEVELOPMENT

A NEW attack on the cancer problem, which combines the techniques of physics and biology and has already disclosed the existence of bioelectric differences between cancer-susceptible and cancer-immune mice, is described by Drs. H. S. Burr, G. M. Smith and L. C. Strong, of the School of Medicine of Yale University, in a report appearing in the *American Journal of Cancer*.

The electrodynamic field of a mouse shows a characteristic change incident to the development of cancer. Mice that developed cancer before the two-hundred and sixtieth day showed marked rises in potentials, amounting to several thousands of microvolts, in readings across the chest. An astonishing fact pointed out by the investigators is that the voltage rise appeared in some cases from 10 days to 2 weeks before the tumor or cancer could be detected by palpation.

Their findings, they conclude, make it clear that "the onset of adenocarcinoma of the mammary gland does something to the electrical pattern of the organism which can be measured with some degree of certainty. In the absence of exact information, it would seem probable that this effect upon the bio-electric properties is initiated at about the time the new growth appears. The data suggest, moreover, that as the new growth proceeds, the chest potentials go up until they reach a peak not long after the tumor becomes palpable. This increase in voltage across the chest is not unlike the increase in head-tail gradients recorded in the salamander and chick. Unlike the growing embryo, however, the chest potentials return to within normal limits in from two to four weeks. This suggests that the animal has established a new equilibrium with respect to the new growth."

ITEMS

DRILLING forty feet below the surface to locate buried sea deposits of millions of years ago in the vicinity of Washington, has been made simpler through the development by Dr. N. H. Darton, retired member of the U. S. Geological Survey, of a special earth-auger. Financed by the Geological Society of America, Dr. Darton is using this tool, to make an underground survey of the District of Columbia. Although in his seventy-third year, Dr. Darton puts in long hours in the field, studying these previously-inaccessible deposits. Collaborating in this work is Dr. Arthur Keith, another retired Geological Survey member, who retains his interest in field work. The report of the findings will be published by the U. S. Geological Survey.

TUNGSTEN, chromite and magnesite, found on the supposedly barren Kamchatka Peninsula, stretching out eastward from the Asiatic mainland, belie the long-standing geological opinion that there is nothing there, according to reports from Tass, Soviet news agency, describing explorations in Kamchatka by Soviet investigators during the field season of 1937. Three thousand square miles of the northern peninsula were explored by the party during 1937. Work is scheduled to continue during 1938.

ENGINEERS at the Los Angeles Institute of Radiology are assembling the world's largest cascading transformer to step up power obtained from local power supplies to 1,000,000 volts to produce penetrating x-rays. Five separate transformers, each stepping up the current by 200,000 volts, will be linked in series to produce a current that will generate extremely "hard" or short x-rays, useful in treating cancer. Only the penetrating short rays are useful for cancer and the higher the generating voltage, the greater the percentage of the desired radiation. The installation is being made by Westinghouse engineers.

SHELLED Yellow Dent corn is highly preferred by the Hungarian partridges, prairie chickens, rabbits and squirrels fed at the thirty maintained stations in southeastern Wisconsin game areas. The measuring stick for wildlife food preference was the residues of other grains found in the 15 compartment food troughs. Usually the corn compartment was empty before a noticeable amount of other grains had been eaten. Food favorites other than Yellow Dent corn included wheat, buckwheat, corn and buckwheat mixed in equal quantities, yellow popcorn and barley. Actual comparisons showed that at one pheasant station ten parts of corn were eaten to three of buckwheat, while at a quail-partridge station the consumption of corn was three times that of barley and thirty times that of oats. Unexplained was the observation that some foods highly recommended for use in winter feeding, such as Black Amber sorghum, were taken sparingly if at all.

SCIENCE NEWS

Science Service, Washington, D. C.

VITAL SUBSTANCES AND OPTICAL ACTIVITY

LIFE may have its mysteries, but scientific investigators have one method of prying open, a bit, the door that guards the secrets of the atoms which compose living tissue. The wedge is the fortunate fact that those substances most essential to life—the enzymes, hormones and vitamins—are optically active.

Thus by noting whether they rotate a beam of polarized light clockwise or counter-clockwise, and to what degree, new facts on the most fundamental problems of man's existence can be found. The outstanding experimenter in this field is Dr. Phoebus A. Levene, of the Rockefeller Institute for Medical Research, who recently received the William H. Nichols gold medal of the New York section of the American Chemical Society for his discoveries.

The ability of many vital substances to rotate polarized light, said Dr. Levene in his address of response in accepting the medal, arises because their molecules are characteristically lop-sided or dissymmetrical. "To-day organic catalysts, by virtue of their specific dissymmetry, have become the most effective tools in researches on structural problems in the field of natural products—carbohydrates, proteins, hormones. Enzymes and substrates, the substances upon which enzymes act, are structurally dissymmetric substances, and the action of enzymes upon substrates depends upon the fitting together of the two dissymmetries, as a key fits into a lock."

The job of the organic chemists, Dr. Levene continued, has been to alter chemical molecules, one step at a time, and rearrange them to see how they fit. The job chemically resembles the efforts of a jig-saw puzzle fan, except that the parts are so tiny that they can not be seen. As the shapes of the molecules are altered the changes can be studied by the shifts in their ability to rotate polarized light.

Dr. Levene showed tables indicating that in some cases the direction of optical rotation depends entirely upon the arrangement in a molecule of the groups, or atoms, around the asymmetric atom in a clockwise or counter-clockwise order, according to size or volume. Another new finding is that in many cases substances which rotate polarized light to the right (substances having dextro-rotary properties) seem to have their inner-molecular groups arranged in clockwise order and in diminishing volume. This rough empirical rule is obeyed when the molecules are viewed with the heaviest groups toward the observer and the light passing toward the observer. Dr. Levene indicated that this discovery developed from a mathematical formula originated by the British mathematical physicist Boys. While Boys's rule is not applicable in general, it has been found valid for such organic chemical groups as the primary and secondary carbinols and the corresponding amines.

COSMIC RAYS

UNDERSTANDING of the cosmic ray has beeen furthered by the discovery at Harvard University that many of the strange new particles found in the rays last year are destroyed in a split-second cataclysm which, without leaving a shred of evidence, explodes their million-volt energies. The particles, found independently by Professor Jabez C. Street and Dr. Edward C. Stevenson, of Harvard, and Drs. Carl Anderson and Seth Neddermeyer, of the California Institute of Technology, are unlike any other fundamental bits of matter. They are the most penetrating projectiles known to man. Tearing earthward from outer space at energies ranging up to hundreds of billions of volts, they can easily blast through several inches of dense, solid lead.

According to Professor Street and Dr. Stevenson, however, many of these particles dribble off energy as they collide with atoms in the atmosphere, apparently reaching a critical stage at which one single collision will stop them in their tracks and completely dissipate their great store of remaining energy. Just when this stage is reached, why one smash-up should wreck these pile-driver projectiles, they are not prepared to say, nor are they certain exactly how these catastrophes occur. The cataclysms follow no known physical laws and are entirely unpredictable. To answer these and other puzzling questions a new type of cosmic ray "telescope" and atomic "speed trap" has been designed which will soon be put into operation for better observation of the cataclysm. An automatic recording device is already photographing the paths of some fifty cosmic-ray particles daily for them.

Preliminary experiments indicate that the new-found particle has an electric charge about equal to that of the ordinary atomic building blocks, the proton and the electron. Its mass, however, is about 130 times as great as that of the electron and just about one fourteenth that of the proton. Its tremendous penetrating power, of course, also marks it off from other particles of matter. Indeed it was this stupendous force which led to its original discovery. As Professor Street and Dr. Stevenson visualize the cosmic ray bombardment, one of the small particles might start from outer space with an energy of billions of electron-volts. Small amounts of this energy are probably lost through collisions with air molecules or even solid material as the particle shoots toward earth. A head-on smash-up with a lead plate might cost it a few million volts of energy per centimeter, a noticeable but by no means large loss.

Down to a certain critical energy value—possibly at several hundred million volts—the particle's energy loss apparently proceeds with fair regularity. At some as yet not accurately determined critical energy range, however, the chances are that one single collision may stop the particle altogether, exploding all its remaining energy in one lightning holocaust. This range probably extends from zero up to about four hundred million electron volts. Thus a particle which has easily smashed through several inches of lead plate may, in this critical energy range, succumb to a sheet of lead only a third of an inch thick or even less. This has been the most puzzling aspect of the discovery, for this energy loss is entirely out of pro-

portion to other earlier energy losses by the particle. In attempting to unravel the mystery, the two investigators have been looking for possible products of the catastrophe but thus far have been unable to find any.

HERMES

THE best estimates now indicate that Hermes, or the Reinmuth Object as it was tentatively known after its discoverer, Dr. Karl Reinmuth, of the Königstuhl Observatory, came 16,000 miles closer to the earth than first computations indicated. This is based on a 4 per cent. revision of an approximate approach within 400,000 miles. The recomputation of Hermes's orbit, announced by Professor Harlow Shapley, director of Harvard College Observatory, is based on work done by D. M. Beard, a senior student of the University of California at Berkeley.

When discovered last October, Hermes, having a size estimated at about one mile in diameter, broke all records for close approach to the earth by an object greater than the mere specks which are recognized as meteorites, or shooting stars. It came within less than 400,000 miles of the earth and for a brief time was closer than any other astronomical object except the moon.

To astronomers the new calculations are interesting, not because they lessen the distance between nearest approach of Hermes and the earth, but rather because the calculation of the orbit of this asteroid has been one of considerable difficulty.

In the February issue of the *Journal* of the British Astronomical Association, Dr. A. C. D. Crommelin, fellow of the Royal Astronomical Society, comments on this point, saying: "The orbit of this little body offered great difficulty to computers, who found the distance from the earth was not indicated very definitely from the observations at first available; at length two positions from a plate taken by C. Jackson at the Union Observatory, Johannesburg, gave the means of getting the asteroid's parallax by a combination with the European positions." Dr. Crommelin estimates that the closest possible distance, for the most favorable positions of the orbits of the earth and Hermes, is about 220,000 miles. This assumes that the present orbit of Hermes will remain unchanged; a condition—it should be added—which few seriously believe will persist because of the perturbations produced by the earth and the sun at each near approach of the asteroid. Based on calculations of the orbit the next appearance of Hermes within the range of telescopic visibility will be in 1940, but the approach then is not expected to be as close as the last one of October, 1937.

In the last six years several asteroids which approach very closely to the earth have been located. Eros, one about twenty miles in diameter, which was found in 1898, long had the record as the closest, as it came within 14,000,000 miles. But in March, 1932, Dr. E. Delporte, of the Belgian National Observatory, found one that comes within 10,000,000 miles. This he named Amor. The following month Dr. Reinmuth found one, which he later named Apollo, and which can come within three million miles. Then Delporte scored again, for on February 5, 1936, he found one that came within 1,376,000 miles. This was named Adonis. Astronomers do not believe that these objects are really getting closer to earth than they have been before. It is merely that a much closer watch, with more efficient telescopes, is being kept. Some years ago, all of them would probably have escaped scrutiny.

A NEW BLIND LANDING SYSTEM

A NEW blind landing system which gives the airplane pilot a "picture" of the unseen airport runway he is approaching was described by Irving R. Metcalf, veteran pilot and radio engineer of the Bureau of Air Commerce before the meeting of the Society of Automotive Engineers held recently in Washington.

Still under development, the device combines ultra-short radio waves, the plane's "artificial" horizon and a cathode ray tube to bring before the pilot's eyes the equivalent of the fog-bound airport landing lights. Highly valuable too is the fact that the new system combines into one instrument the duties now performed by nine separate devices. This simplification is a major advance in flying technique.

Three electron "guns" inside the cathode ray tube shoot electrons against the tube's fluorescent screen and produce three brilliant spots. When these spots are lined up horizontally the pilot knows that he is going down the correct glide path to his landing. The radio signals and the artificial horizon aim the "guns" so that the spots give the relative position of the plane at any instant and the pilot swings his plane until the dots line up properly. The three dots reproduce the behavior of three reference landing lights on the landing field in a system suggested by Mr. Metcalf a few years ago and installed at eighteen airports.

In the light system, which is now reproduced in the plane by radio means, a light sunk in the center of the runway, and a light on each side of the runway are used to tell the pilot whether he is making a proper approach. Squinting at the lights through cross-hairs, the pilot knows he is on course if the three lights appear in a horizontal straight line and the center light is at the intersection of the hairs. If the center light is to one side, the pilot knows his plane is off course on the same side. If the center light is above the other two, the plane is above its proper approach path; if below, the plane is below the proper approach path. In the radio system four antennae, fed by one radio transmitter, send out signals, one of which moves the dots in the cathode ray tube up, one down, one to the left and one to the right. When the pilot is on course the signals neutralize each other and the dots are in their proper position. If he is off course, the dots move in the direction in which the plane has veered.

Under the new system the plane approaches the field in a straight line, ready to land at any moment, instead of approaching in a steep glide and then leveling off near the ground. The advantages cited for the straight glide approach are this readiness to land, should the pilot be nearer the ground than he imagines, and the slower approach speed.—LEONARD H. ENGEL.

ITEMS

DR. R. W. BROWN, paleontologist of the U. S. Geological Survey, in a report given before the Geological Society of Washington stated that the Hell Creek beds of Montana and North Dakota, long a puzzle to paleontologists because they seemingly contained dinosaur bones and plant remains which belong to an age when dinosaurs were extinct, should be classified as two separate formations. Now, with the fossil-containing beds reclassified, Dr. Brown puts the Hell Creek formation in the Cretaceous age, along with the other dinosaur-containing beds of North America, and the overlaying beds, formerly such a puzzle, in a new age, the Paleocene, a period of transition from the age of reptiles to the age of mammals.

NATURAL color slow motion pictures of the electric arc, which appears to the naked eye as sputtering brilliant sparks, reveal one of the least understood of natural phenomena to consist of brilliantly colored flames, slowly pushing out tiny flashing globules of molten metal. Taken by Dr. C. G. Suits, of the General Electric Company, the film shows differently colored flames for different gases. The flames wander gracefully around the edges of the electrodes for an interval before becoming more or less stable at the electrode tips. One thousand frames per second, with exposures of 1/10,000 of a second for each frame, were taken by Dr. Suits to show what goes on in the arc.

A NEW device for measuring the thickness of coatings, like tin-plate, on iron or steel surfaces, has been developed at the National Bureau of Standards. The merit of the method is that the surface or sample is unharmed by the magnetic apparatus. Developed by Abner Brenner, of the electrochemistry section, the method depends on the decrease in attraction of a permanent magnet by steel when the two are separated by a non-magnetic coating. Coatings only fifteen thousandths of an inch thick can be measured by the method. Accuracy within an error of ten per cent. is claimed. In 1936 a patent was granted to three Pittsburgh inventors for a somewhat similar device which utilized a small electromagnet, contained in a pencil like device, as the source of the magnetism. Mr. Brenner's newer apparatus uses a permanent magnet. In the patented article the "pencil" was moved over the coated surface and changes in electric current, induced by the changing degree of magnetic attraction, were calibrated with coating thickness.

RADIOACTIVE minerals in a rare ore sample from Jimtown, Colo., were recently determined without destroying the mineral by Dr. E. N. Goddard, U. S. Geological Survey mineral expert, by a new use of the test by which radioactivity was discovered. Placing a polished face of the ore sample on a sheet of film, and leaving it untouched for some time, Dr. Goddard was able to determine, after the film was developed, the presence of pitchblende, a strongly radioactive ore of uranium, by its intense black markings on the film, and cerite, a weakly radioactive ore of cerium, from its gray markings. Substances that were not radioactive left no marks on the film. Later analyses of this ore sample showed that it was about 940,000,000 years old, placing it among the oldest rocks known, formed during the long eras before life appeared on earth.

SCIENCE NEWS

Science Service, Washington, D. C.

SLIP PLANES OF ALLOYS

THE bending or distortion of metals occurs because the planes of the atomic crystal groups slip over one another. The softer the metal the easier this slip occurs. To produce hard alloys what might be called "atomic sand" is put between the slip planes to stop the ease of slipping and hence make the metal harder. Thus, in summary, did Professor Robert F. Mehl, director of the Metals Research Laboratory of the Carnegie Institute of Technology, outline the behavior of metals in his Priestley Lecture at the Pennsylvania State College. The lecture is one of five on the subject "Reactions in Solid Alloys." The Priestley lectures are yearly given by some invited scientific man to honor the memory of Joseph Priestley, discoverer of oxygen, who came to Pennsylvania in 1794 after persecution in England. Priestley's influence on the progress of science in America was very great.

It is postulated, said Dr. Mehl, that among the chemical reactions which can occur in the solid metallic state is that of precipitation in which one metallic element in an alloy can, if conditions are right, precipitate out. To explain the growing hardness of some alloys with age it has been suggested—and generally accepted—that this precipitation can occur along the slip planes between atomic groups in the crystalline metal. This precipitate, in its way, acts like sand under the slipping wheels of a trolley car in that it stops the slip. For metals this decrease of slipping represents increased hardness.

It has been found that there is some optimum size of atomic precipitate which induces the greatest hardness. If the metal is heated these little bits of "atomic sand" grow in size and eventually grow so large that they are too big to prevent slip effectively. Thus, one can increase the annealing temperature of metals by steps and find some temperature which produces the maximum of hardness in the metal. Below and above this point of annealing temperature softer metals will result than at the temperature where the maximum hardness is produced. Dr. Paul Dyer Merica, of the International Nickel Company, developed this precipitation hardening theory while at the National Bureau of Standards in Washington.

A SYMPOSIUM ON SOLUTIONS

MAN has been using sugar in his tea and salt in his porridge for many, many years as flavoring and seasoning. But if you set out, as have so many of the world's greatest chemists, to seek the explanation of what happens to the dissolved sugar or salt, you will find yourself on the trail of one of the toughest problems of science; the study of solutions and their many properties.

Those speaking at the symposium on "Ions in Solution," held at the Franklin Institute, were Dr. Herbert S. Harned, professor of chemistry, Yale University; Dr. Duncan A. MacInnes, Rockefeller Institute for Medical Research; Dr. Charles A. Kraus, professor and director of chemical research, Brown University, and president-elect of the American Chemical Society, and Dr. Victor K. La Mer, professor of chemistry, Columbia University.

Dr. MacInnes described the behavior of substances in aqueous solution for his research organization is primarily interested in studying problems of the human body. And water is the solvent widely used by the body of man. Dr. Kraus discussed the behavior of substances in solvents other than water because theoretically and even industrially water is not, perhaps, the best solvent which can be used in many cases. Dr. Harned described the relation of the laws of heat and thermodynamics to a study of solutions, for one of the ways to study solutions accurately is to check their boiling points, their freezing points and many other matters bound up intimately with the laws governing the interchanges of heat and energy which is the concern of thermodynamics. Dr. La Mer, final speaker on the symposium, described the motions of those carriers of electricity, the ions, which move about—or "swim," as it is sometimes said—freely in some solutions. It is the ions of various atoms which make atoms of silver rush across a solution and deposit as silver-plating on silverware. And it is the ions, also, which transport the electricity inside the battery of the car; electricity which goes along wires to the starting motor and spins the heavy, powerful engine beneath the hood.

METEORITES

EXPLODING atoms of radium, giving off helium, lead and energy, now tell the ages of many meteorites which wandered into the earth's gravitational field, later crashing to earth with fiery brilliance.

Some of them, according to figures recently published by Dr. Wm. D. Urry, physical chemist of the Massachusetts Institute of Technology, who has been analyzing rocks for many years to determine their ages, are less than 100,000,000 years old, while others are as much as 2,800,000,000 years old—about as old as the solar system. Dr. Urry's analyses, painstakingly made from samples of the meteorite, tell the age of its solidification, and not the time when it fell. Thus, some meteorites were molten during the age of dinosaurs on earth, while others solidified just as the solar system was being formed.

The oldest meteorites, according to Dr. Urry's figures, could truly be "chips from creation," left over from the great mass of material pulled from the sun when the planets were formed. Others, unless they stayed melted for more than two billion years in the bitter cold of space, could not be left-overs. They must have been formed some other way. Until recently, it was believed that meteorites were remains of a small planet, or group of planets, whose orbits were beyond Mars. This planet, on breaking up, created the meteorites. Now, with the ages of the meteorites shown to be different, the theory of a disrupted planet may need to be revised.

Many of the stony meteorites show evidence of having been broken and recemented, while others have undergone

other alterations just as a rock on earth might in the course of its history. All the rocks, however, are of the primary type—they were melted once, but none of them resemble earthly sediments, such as sandstone or shale. The iron meteorites resemble the earth's interior as it has been described by geophysicists, whose instruments tell them facts about places they will never see.

Comets, when they cool and compact into large masses from clouds of luminous dust, are the source of meteorites, according to another theory. Some geologists believe that meteorites do not come from the solar system at all, but that they are wanderers from outer space, attracted into the solar system by the sun's pull, and only incidentally pulled to earth. The new figures do not solve the riddle of the meteorites, but only show that they are of widely differing ages.

AIRPLANE MATERIALS

THE modern airplane may symbolize man's adoption of the light metal alloys like aluminum and magnesium, but old time-tried steel is by no means outmoded for aerial transport. Over 17 per cent. of the basic weight of a large modern transport (the plane with engine, propellers, starters and all accessories) consists of steel, according to J. Richard Goldstein, of the Douglas Aircraft Company, at a meeting of the Western Metals Congress, which was recently held in Los Angeles. On a big 21-passenger transport the total steel now used weighs about a ton in all. This steel appears in 24 different kinds of alloys. If airplane designers considered only strength of materials for their given weights there would be little to choose between wood, aluminum alloys, magnesium alloys and steels. The strength-weight ratios of these four common structural materials are so nearly equal that most fair-minded authorities admit intelligent design with any of the materials can result in a structure of very nearly the same efficiency. The difference becomes more important when one considers such items as the number of units to be built, their size, and the type of service for which the plane is intended.

America's supplies of magnesium are practically inexhaustible, said A. W. Winston, of the Dow Chemical Company, Midland, Mich., on the same program. They exist as magnesium chloride or as magnesium carbonate in dolomitic limestone and magnesite. It is the magnesium chloride found in the salt brines from wells in central Michigan which provides the nation's major source today. Landing wheels and engine parts are the principal American applications of magnesium alloys in airplanes. Landing wheels on the largest airplanes, if made of magnesium alloys, would mean a weight saving of 150 pounds, or the weight of another passenger. Thus at present air travel fares a plane with such wheels could theoretically save $149.95 for each New York to Los Angeles trip. Admitting that all of this saving could not be realized, Mr. Winston added, the opportunity still exists for increased payloads through weight reduction by the use of light-weight alloys. In Europe magnesium alloy propellers have been used for some time and in the 1934 European Air Derby 26 of the 34 entries had such propellers, including the first six planes to finish. Germany, which has pioneered in the use of magnesium alloys for airplanes because of its lack of aluminum resources, produced the great 12-engined flying boat, the *DO–X*, which had its main spars of magnesium alloy. This giant airplane—ten years ahead of its time as far as size—successfully flew the Atlantic.

BRAIN WAVES AND THE DIAGNOSIS OF TUMORS

THE brain's electrical waves are being used to diagnose the presence of cerebral lesions such as tumors and scars by Dr. Theodore J. Case, neurophysiologist of the University of Chicago. Eleven cases have shown that a diagnostic procedure has been perfected that uses brain waves just as the electrocardiograph is used in diagnosing heart disease. Dr. Case, in reporting to the Chicago Neurological Society, pointed out that the brain wave method could not yet be used as the sole guide for the physician in his diagnosis and had to be used in conjunction with other means such as x-rays or drilling a hole into the skull.

Dr. Case said his technique had important advantages of not causing the patient any pain or discomfort and of detecting lesions in the so-called silent areas of the brain. These lesions can not be detected by neurological symptoms as are those in the motor areas. Research workers have known for some time that the brain's nerve cells pulsed electrically at a regular cadence all the time and they perfected methods for amplifying these pulsations and recording them. Normal brains show frequencies between eight and forty waves per second, the most common being the ten per second alpha wave.

In the cases reported by Dr. Case and verified either by operation or autopsy it was found that lesions are denoted by localized regular waves with a frequency of one to three per second, by very slow waves varying from one in five to one in two seconds, and by irregular spike or sawtooth waves. The most common indication of a lesion was the localized regular wave with a frequency of one to three per second. The abnormal waves were localized with respect to the lesion which could be closely defined by shifting the electrodes until the characteristic waves were strongest. The research was supported by a grant from the Otho S. A. Sprague Memorial Institute.

THE PREVENTION OF LEPROSY

A DEFINITE plan for conquering leprosy by eradicating it from future generations was presented by Dr. H. E. Hasseltine, medical director of the U. S. Public Health Service in charge of the National Leprosarium at Carville, La., at the International Leprosy Conference which opened recently at Cairo, Egypt.

Dr. Hasseltine's plan is to establish a Preventorium, in the vicinity of the National Leprosarium, to which children of leprous parents may be admitted, cared for and educated at government expense until they reach their majority. Such a plan, Dr. Hasseltine believes, would go a long way toward conquering leprosy, in the United States at least, because it would prevent its development in future generations. Nothing like a specific remedy has yet been discovered for this age-old

plague, so preventive measures must be used as far as possible. The Preventorium might not be practical in countries where there are large numbers of lepers, but he believes it would cut down the number of lepers in the United States in the future.

Leprosy in children can generally be traced to infection from a leprous parent or other relative, such as a grandparent. This is probably not a matter of inheritance but of infection by contact. When a child is taken from its leprous parent at birth, it may escape the disease. This much Dr. Hasseltine has learned from his long study of leprosy both in the United States and Hawaii, although he points out that much is still unknown about how leprosy is transmitted. The mystery is a hard one to pierce because apparently many years may elapse between the time when a person, often unknowingly, picks up the germ of leprosy and the time symptoms of the disease first appear. By putting children of lepers in a Preventorium, Dr. Hasseltine points out, many cases can be prevented, those that do develop will be detected early when treatment is of most benefit, and the children will in general be better fed, housed and clothed than in their poverty-stricken homes. The cost for maintaining and caring for these children would be no more than for maintaining and caring for an equal number of lepers, and spending the money on the children of lepers may cut down the future number of lepers, thus proving an economy in the end.—JANE STAFFORD.

USEFUL EMPLOYMENT AS A HEALTH MEASURE

USEFUL employment—with emphasis on the useful—for all who are able and willing to work was urged as a public health measure by Surgeon-General Thomas Parran, of the U. S. Public Health Service. Speaking "as a doctor" before a Senate committee to investigate unemployment and relief, Dr. Parran said: "Whatever the cost, I would urge that from the standpoint of public health, in its larger concept—of mental health—economic factors are subordinate to the vital necessity of providing for our destitute citizens an opportunity of a livelihood earned by individual effort. We can not for long years and perhaps generations repair losses to human character and mental health which will result from a failure to give useful employment to our citizens. The vicious circle of poverty-disease-poverty can best be broken, Dr. Parran said, "by doing what we know how to do to improve the health of the underprivileged groups."

He cited figures from the recent Public Health Service survey showing that there is much more illness among the unemployed and much less medical care than among those in more comfortable economic circumstances, and that disease is a larger factor in unemployment and unemployability. Unemployment and economic worry were among the factors causing mental illness and breakdown in as high as one fourth of first admissions to mental disease hospitals during depression years, according to hospital superintendents' estimates. Illness and death due to tuberculosis, syphilis, pneumonia and cancer could be greatly reduced by applying present knowledge to all classes of the population. Death rates from tuberculosis among the unemployed are now as high as they were for the entire population in 1900. The reduction in the general tuberculosis death rate during the years since 1900 hides the high death rate among lower economic groups.

ITEMS

VANADIUM, hard-to-get steel-alloying metal, usually mined at high labor cost and other expense in out-of-the-way desert and jungle regions, is now being produced at the rate of 200,000 pounds annually from the flue deposits of steamships burning Venezuelan oil, according to a report by Jerome Strauss, vice-president of the Vanadium Corporation of America, producer and importer of this rare metal. Vanadium occurs in very small and quite variable amounts in almost all crude petroleum, but only the Venezuelan and Mexican oils provide enough vanadium to be of commercial value. In recent years, this vanadium-bearing petroleum has been burned by steamships, and the non-inflammable vanadium oxide left behind with the soot and coke, from which it is recovered when the burners of the steamships are cleaned. Occurring in concentrations of from 5 to 25 per cent., in these soots and cokes the vanadium oxide is extracted in the United States, Japan and England.

No commercial oil wells are likely to be drilled on the Atlantic Coastal plain, according to a report made by Miss Olive C. Postley, of the U. S. Geological Survey, to the American Association of Petroleum Geologists, because the oil-barren basement rocks are too close to the surface, often being encountered at depths of less than 1,000 feet. More drilling will be necessary in Georgia and southern Florida before any statement about oil reserves there can be made. In these areas, few deep wells have been drilled, and the underlying rocks are largely unknown.

THE carcass of a mammoth, recently found whole and frozen in the icy soil of Wrangel Island, is to be removed to Moscow by a special expedition of the Academy of Sciences of the U.S.S.R., according to a report by Tass. The expedition will move in three parties. The first group, consisting of three scientists, left Irkutsk by air for Wrangel Island in the beginning of March. They mounted guard over the carcass and began the excavation and exploration of the island. The second group will sail in May or June from Vladivostok to the estuary of the Anadyr or Providence Bay and from there will reach the island by air. In this party, an expert on permanently frozen soil and a zoologist participating in the expedition will make investigations. The third group will sail from Vladivostok in a steamer specially equipped for transferring the carcass. It is expected that the ship will reach the island in August. The carcass will be brought to Vladivostok and stored in a refrigerator. Because of its large size it will probably prove impossible to carry the whole carcass in a railway car to Moscow. In this case the mammoth will be dissected in Vladivostok.

SCIENCE NEWS

Science Service, Washington, D. C.

EXPERIMENTAL BIOLOGY AND NUTRITION

VITAMIN E, called the fertility or anti-sterility vitamin because rats need it in order to bear young, is apparently not a diet need of farm animals. The studies showing this were reported by B. H. Thomas, C. Y. Cannon, S. H. McNutt and G. Underbjerg, of the Iowa State College, to the meetings of the American Institute of Nutrition, held recently in Baltimore in conjunction with the meetings of the Federation of American Societies for Experimental Biology. It was pointed out that the effect of Vitamin E deficient diets has not hitherto been determined for farm animals. Feed mixtures that lacked vitamin E and that kept rats from bearing young were given to goats, sheep and rabbits. Male and female goats were able to reproduce through several generations unhampered by the lack of the rat anti-sterility vitamin. The same occurred with rabbits. Young lambs fed on a diet lacking the anti-sterility vitamin are nevertheless showing unmistakable signs that they will shortly bear young. Studies of rats in the past has yielded much valuable information on diet and vitamins that has been applicable to farm animals and to man. Apparently the effects of special diets are not invariably the same in rat nutrition as in other animal nutrition.

NUTRITION workers are stressing more and more the importance of eating a plentiful supply of vitamins and are finding more and more evidence that a minimum amount is nearly as bad as no vitamins at all. The latter leads to serious disease, such as rickets, scurvy and beri-beri. A minimum amount of vitamins may prevent these, but this minimum supply is not enough to prevent minor degrees of ill health. Further evidence along this line was reported by Drs. A. U. Orten, C. G. Burn and A. H. Smith, of Yale University. Slightly subnormal growth, respiratory infections and a relatively high mortality occurred, they found, among rats that were in a chronic state of mild vitamin A deficiency. Tooth disorders occurred, tumors developed, and the normal harmless bacteria of the lining of the digestive tract were displaced by potentially disease-causing bacteria. Similar evidence for the need of an abundant supply of the scurvy-preventing vitamin C was presented by Drs. C. G. King, A. Sigal and R. R. Musulin, of the University of Pittsburgh. Guinea-pigs fed minimal amounts of vitamin C did not develop gross signs of scurvy, but their tissues were more sensitive to injury by the toxin of the diphtheria germ and other bacterial toxins than the tissues of the guinea-pigs that received ten times as much vitamin C.

A NEW method of learning more about the aging process with facts that already upset some common ideas about old age and length of life were reported by Drs. C. M. McCay, L. A. Maynard and G. Sperling, of Cornell University, at the meeting of the institute. Long life, it appears, goes with a slow rate of growth, rather than with rapid growth as has been commonly believed. "The life span is flexible," according to Dr. McCay, "and the extent to which it can be increased is an unknown value." The method consisted in retarding the growth of young white rats by cutting down their daily supply of calories. The normal life span of these animals is about 600 days. Some of the animals had their growth retarded for 1,000 days, by which time all the normal animals of their generation were dead. The retarded rats, however, tended to remain young in appearance in contrast to those that grew normally, the latter passing through the usual period of old age.

ARTIFICIAL radioactivity may replace the surgeon's knife and other methods of treating cancers of the thyroid gland and simple goiters due to overgrowth of the tissue of that gland. This future application of one of the latest developments of modern physics was reported by Drs. Saul Hertz and Arthur Roberts, of the Harvard Medical School at the meeting of the Federation of American Societies for Experimental Biology. The application of artificial radioactivity to the conquest of cancer is one of the aims of the atom-smashing experiments being conducted by physicists on a wide front. One of the difficulties with the use of radium and x-rays is that of getting the cancer-destroying rays into the cancerous tissue without harming healthy tissues. Radium needles, million-volt x-ray machines and elaborate ray-screening methods have been developed in the hope of overcoming this difficulty. Since some chemicals make their way to certain parts or tissues of the body and are deposited there, the physicists hoped that by giving these radioactivity, they would have a way of getting the cancer-destroying rays into the tissues where they are needed. The research reported is one of the first forecasts that this aim may be accomplished. Iodine is one of the substances that can be made radioactive by the cyclotron. When this radioactive iodine is injected into a vein, almost all of it makes its way into the thyroid gland. This was discovered by injections of radioactive iodine into the veins of rabbits and presumably would be true in the case of man as well. Radioactive iodine in the thyroid gland should act like radium needles or seeds, giving off beta rays that can destroy cancer and check overgrowth of other cells. When greater supplies of radioactive iodine can be made, it should be possible to use it in treating patients.

A CLUE as to why and how sulfanilamide, the new chemical remedy for a variety of infectious ailments, achieves its spectacular cures has been found by Drs. H. A. Davis, L. C. Harris, Jr., and H. C. Schmeisser, of the University of Tennessee. The chemical, it appears from their studies, activates the system of cells that destroy micro-organisms or other harmful cells. Included in this group are cells of the spleen, of the liver, of lymphoid tissue and the macrophages of the general tissues of the body. All

these cells have the function of protecting the body from harmful foreign material, including disease germs, by enveloping the invading enemy cells and destroying them. The exact action of sulfanilamide and the related Prontosil has been something of a mystery, since the chemicals have not shown much direct germ-destroying power themselves. Solutions of the chemicals put in a test-tube with disease germs did not kill the germs to any extent, even though the chemical when given as medicine cured the disease caused by the germs. The new clue to how sulfanilamide acts in the body to overcome germ infection was found by study of the tissues of white rats that had been given daily injections of the chemical over a period of three months.

THE scientific game of tag being played with heavy hydrogen (deuterium) and heavy nitrogen since the discovery of these new substances is being extended to follow the course through the body of protein from foods such as meat and eggs. Reports of how this can be done were given by Drs. R. Schoenheimer, G. L. Foster, D. Rittenberg, S. Ratner and A. S. Keston, of Columbia University. So far it has been found that the amino acids, which are the building stones of proteins, can take up these new heavy substances. Since this means that the deuterium- or nitrogen-tagged particles of amino acids can be easily located, investigators will probably be able to learn much more about what happens to proteins in the body, from the time they are eaten until the various protein constituents have gone through the processes of digestion and conversion into new body tissue.

ALMOST any school child can tell you that insulin is the life-saving and life-maintaining remedy for diabetes and that it helps the body use the sugar in food. No one, however, can tell you exactly how insulin accomplishes this effect. The newest suggestion comes from Drs. Samuel Soskin and R. Levine, of the Michael Reese Hospital and the University of Chicago. They find that insulin acts something like a ferment in some intermediate step of the chemical processes that sugar and starches undergo in the body before they are burned for immediate energy or stored. Its action, they state, "resembles that of an activator or coenzyme." Insulin, they found, has only a relative effect on the rate at which sugar and starches are used by the body. The rate depends on the amount of sugar in the blood, whether insulin is present or not. Insulin increases the rate of sugar utilization and storage (as glycogen), but these two processes of utilization and storage go on, although more slowly, in the absence of insulin. Insulin is needed, it appears, to keep the rate from being so slow as to make the individual sick.

CATARACTS of the eyes of old people and of diabetics seem to be linked with the way the body uses food substances. Research bringing sugar and proteins into the picture was reported by Drs. Helen S. Mitchell and Gladys M. Cook, of the Massachusetts State College. Cataract occurs in rats within two weeks if they are fed a diet in which one fourth of the ration is galactose, Dr. Mitchell found in earlier studies. Galactose is a sugar not found as such in nature, but formed in the body from milk sugar. Proteins from egg albumen, lactalbumen, beef muscle, fish muscle and soy bean meal can prevent the development of the galactose-caused cataract, Dr. Mitchell and her associate have now found. Egg albumen was most effective and the amount necessary to prevent completely cataract formation was 45 per cent.—nearly half—of the diet. Practical application of the research, such as definite dietary regulations for cataract prevention, has by no means been reached yet, but may be hoped for, it appears, after further study along these lines.

FUTURE victims of poisonous over-doses of certain modern sleeping potions may be rescued by having their blood literally washed out with a salt solution. Discovery of this new type of antidote for barbiturate poisoning was reported by Drs. R. A. Cutting and T. Koppanyi, of Georgetown University Medical School. The method was demonstrated by moving pictures. The discovery was made in the course of an investigation of what happens to water and chlorides when large amounts of salt and sugar solutions are injected into the veins. This form of treatment is commonly used to nourish a patient who can not eat or can not retain food. These studies were made on animals that had been anesthetized by barbiturates such as sodium phenobarbital. Recovery from the anesthetic occurred in one third to one half the usual time when the animals had been given the salt or sugar solutions. Following this accidental discovery, the possibilities of the blood-washing-out method as an antidote for barbiturate poisoning were investigated. Prolonged massive infusions of the salt solution brought about recovery within eighteen hours in animals that had taken twice and three times the fatal dose of the sleeping potions. In order to achieve this antidotal effect, much more of the solution is given than the amounts generally used now when salt or sugar solution is given for other conditions. To wash out the barbiturate, an amount of fluid equal to from one fourth to three fourths of the body weight is given, according to the severity of the condition. When used for other purposes, from one pint to one quart of sugar or salt solution is given by vein. The theoretical importance of the study, Dr. Koppanyi said, is probably greater than the practical.—JANE STAFFORD.

THE SHAPE OF RUBBER MOLECULES

THE springiness of rubber arises because its molecules have curved shapes roughly resembling the old-fashioned springs on a wagon. After rubber molecules are stretched out straight they will spring back elastically as do the curved wagon strings. Such, in summary, is the new theory of the structure of the important, but baffling, behavior of rubber, as indicated in the technical report presented at the meeting of the rubber division of the American Chemical Society, by Dr. Eugene Guth, of the University of Notre Dame. He pointed out that "The most important and perhaps universally known property of rubber is its high elasticity, which is reversible. Another interesting property is that rubber, when stretched, becomes hot. This phenomenon is easily observable by

stretching a small band quickly and applying it to the cheek. In my theory the high extensibility of rubber is explained by the flexibility of the long rod-like rubber molecules. (A rubber molecule may be as long as the 300,000th part of an inch, whereas an ordinary molecule is only about 1/100,000,000th of an inch long. Along this chain are many smaller molecules in constant rotational motion. This motion is caused by heat and is known as the Brownian movement. In unstretched rubber the long molecules are in a curved form because such a curved form is the most probable form of a flexible chain and nature prefers most probable forms over all others. For example, in throwing a flexible string into the air it falls, in most cases, in a curved form and almost never in a straight form. Therefore one can reasonably assume that the most probable form of rubber's flexible chain molecule is also a curve. To stretch such a chain requires work and this energy is transformed into heat. This explains the heat generated by a stretched rubber band. The retractive force is due to the tendency of nature to prefer the most probable form, that is the curved chain. This same mechanism for the retraction of stretched rubber also explains why stretched rubber contracts, when heated. The reason is that the heat movement is stronger at higher temperatures and therefore causes an even stronger tendency to the curved form.''

Dr. Guth stated that ''In many ways the elasticity of rubber is analogous to that of a gas. Pressure of a gas compressed in a vessel is caused mainly by the heat movement of the gas molecules which have a tendency to expand the gas. The gas-like elasticity of rubber in a tire casing and inner tube is responsible for the harmonious relation of the rubber and the air. There are more than 100,000,000,000 chains of flexible molecules in a cubic inch of rubber. These chains are connected with bridge-like structures so that ultimately we have an elastic network of molecules. The theory is a statistical one: first, because a chain contains many smaller molecules and, second, because rubber is built up of numerous long molecules. It is well known that large numbers can only be dealt with by means of statistical methods. The theory should lead to a better understanding of the properties of rubber which, in turn, will provide a guide in the development of new natural and synthetic rubber products and in the fashioning of rubber in a way to render it more efficient for the use it is intended.''

THE PRODUCTION OF MAGNESIUM METAL FROM SEA WATER

A NEW process for the production of magnesium, feathery-like metal whose successful and cheap extraction would presage an industrial revolution, has been patented in Washington by a German inventor. Differing from previous extraction processes in that it starts with magnesium chloride, a constituent of sea water, instead of one of the common magnesite ores, the process uses hydrogen to combine with the chlorine of the magnesium chloride. Metallic magnesium is the result. The patent has been awarded to Karl Ebner, who comes from a small town near Frankfort-on-the-Main, Germany. He has assigned the patent to the American Lurgi Corporation, of New York City. The relatively low furnace temperature of 1,200 to 1,500 degrees Centigrade is all that is necessary to make the process operate, Mr. Ebner asserts. He contrasts that with the high temperatures required in other processes. The production of magnesium has been the goal of research workers all over the world for, with its extremely low weight and other desirable qualities, it can be used in the manufacture of alloys even superior to aluminum alloys. Of further interest is the fact that bauxite, the ore from which aluminum is extracted by present processes, is not counted a common ore. ''The magnesium is recovered by condensation from the gaseous products of the reaction leaving a mixture of hydrogen and hydrochloric acid, which hydrogen, after separation of the hydrochloric acid, may be returned to the process.''

ITEMS

RISING more than a million miles from the surface of the sun, the highest solar prominence ever recorded was observed at the Mount Wilson Observatory on March 20, the Carnegie Institution of Washington announced. Reports of measurements made by Dr. Edison Pettit on photographs of the prominence indicate that a gigantic mass of erupting calcium and hydrogen gas rose nearly vertically from the sun at speeds first of 40 miles per second, then 80 miles per second, and when last noted, 124 miles per second. Photographs of this eruption were taken by J. O. Hickox. When last observed the solar prominence had risen to 970,000 miles above the surface of the sun. Clouds interfered with further observations. The greatest height hitherto observed for a prominence is 621,000 miles, recorded at the McMath-Hulbert Observatory at Lake Angelus, Mich., on September 17, 1937.

FIFTEEN gun barrels, firing .30 caliber bullets through an oil well casing hundreds of feet below the surface, promises to increase oil production in many fields where several rock strata bear oil. During drilling, each oil stratum encountered is recorded on the well log. Later, when the well is cased to the bottom, the cannon is lowered to the level of each oil stratum, and fired, punching holes in the casing to let in the oil from that bed. Controlled electrically from the well head, this cannon may be lowered as much as two miles below the surface, and fired when it is opposite any desired rock bed. Accurate revolution counters tell the operators exactly how far below the surface the cannon is at any time. Using this method, many oil sands can be tapped by one well, saving the almost prohibitive cost of drilling one well for each oil horizon, or waiting until one horizon has stopped producing, then pulling part of the casing, until the next higher one is exposed.

AN ingenious suction method for simultaneously slowing the landing speed of a high-speed plane and for increasing the lift of its wings is described in a patent granted to Major Alexander P. de Seversky, of New York, designer of high performance military aircraft. Ports placed near the leading edge of the wing connect with suction ports on the under side of the wing toward the rear. Suction thus created simultaneously slows the ship and cuts turbulence on the upper side of the wing, thus increasing lift.

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SCIENCE NEWS

Science Service, Washington, D. C.

SOME PAPERS ON EXPERIMENTAL BIOLOGY READ AT BALTIMORE

CHICK embryos may be useful in determining the cause, prevention and cure of infectious diseases ranging from influenza and whooping cough to encephalitis and Rocky Mountain spotted fever, according to a report made by Dr. Ernest W. Goodpasture, of Vanderbilt University, to the Federation of American Societies for Experimental Biology, which recently held its meetings in Baltimore. Chick embryo tissue so far has been used chiefly in cancer studies. Its advantages for the study of infectious or germ diseases are that it is cheap, germ-free itself, self-nourishing and uniform. Animals have been generally used for these studies. Some of the worst human ailments, however, can not be induced in animals and with animals there is the further disadvantage that ailments of their own and feeding problems may upset the studies. Viruses like those of encephalitis and other germs, such as those of diphtheria and the staphylococci that cause boils and the streptococci of septic sore throat, can all be grown on chick embryo. They produce the same sort of injury to this tissue that they produce in the body tissue of man. Serums and other remedies used in treating human infections can be studied in the infections in chick embryos. In the case of meningitis, for which there are many serums but none that is universally satisfactory, this chick embryo method should be of particular value. Many problems of resistance and susceptibility to disease might also, Dr. Goodpasture suggested, be solved through chick embryo studies.

EQUINE encephalomyelitis, a kind of encephalitis or "sleeping sickness" of horses, may be spread by wild birds and domestic fowl, it appears from studies reported by Dr. Carl Ten Broeck, of the Rockefeller Institute for Medical Research, at Princeton, N. J. Mosquitoes are carriers of the disease but circumstances surrounding epidemics of it suggested that birds also play a part in its spread. It was found that chickens and turkeys can carry the virus cause of the disease in their blood without showing any signs of illness. It may be that mosquitoes pick up the virus from these healthy carriers and pass it on to horses on the same or neighboring farms.

THE outlook for chemical warfare against virus diseases such as infantile paralysis, influenza and encephalitis is not encouraging in the opinion of Dr. Earl B. McKinley, dean of George Washington University Medical School. Attempts by himself and his associates, Jean Sinclair Meck and Ellen Gray Acree, to destroy or check the growth of 5 disease-causing viruses by 3 chemicals, Prontosil, Prontylin and sodium sulphanilyl sulphanilate, under conditions such as would be met in treating patients, all failed. The viruses were those which cause rabbit myxoma, rabbit fibroma, herpes encephalitis, St. Louis encephalitis and choriomeningitis. Two of these chemicals, Prontosil and Prontylin, have proved spectacular remedies for bacterial diseases such as streptococcus sore throats, childbed fever and gonorrhea. Sodium sulfanilyl sulfanilate, a chemical recently reported, has been described as both a preventive and cure for distemper in dogs, cats and ferrets. Prontylin (sulfanilamide) also failed to destroy or check the growth of the infantile paralysis virus in earlier experiments. The reason why the chemicals are ineffective against virus infections may be, Dr. McKinley suggested, because viruses, unlike bacteria, get inside the cells of the body. The body cells seem to protect the virus from attack by chemicals. Bacteria, such as streptococci, are kept out of the cells and ordinarily occupy the spaces between body cells. Here they are easily attacked by the chemicals which hold the bacteria in check until the germ-fighting cells of the body are able to overcome them.

PROTECTION against cancer, so far only for one type of cancer in mice, is possible by use of a vaccine made of chemicals, it appears from research reported by Drs. W. R. Franks and H. J. Creech, of the University of Toronto, at the meeting. No application of the method to man is yet possible, but discovery of this method for protecting mice against cancers caused by certain chemicals may lead to better knowledge of how to fight cancer in man. Dibenzanthracene, one of the most potent cancer-causing chemicals known, was converted into a protein. This gave it the property, when injected into the mouse's body, of producing an antibody, one of those defenders of the body which go into action against invading disease germs and foreign proteins. So although no germs appeared in the picture, the same defense mechanism was set in motion. Of 12 mice given this sort of chemical vaccination, only 4 developed cancers when the cancer-causing dibenzanthracene was injected. Of 13 mice not protected by the dibenzanthracene-protein combination, 9 developed cancers and 1 developed the malignant disease, leukemia. Application of this method to protecting man against cancer appears to hinge on the possibility of discovering the chemicals that may cause cancer in man as dibenzanthracene can cause cancer in mice. Since this chemical is similar in structure to substances normally found in the human body, such as bile acids and some of the sex hormones, chemists have already been working on the angle that a mistake in body chemistry during the manufacture of the bile acids or the sex hormones may give rise to a cancer-causing chemical.

THE report of the chemical vaccination against cancer in mice followed a report of cancer caused by a chemical which normally plays an important part in the body. This report by Drs. G. E. Hall and W. R. Franks, of the University of Toronto, suggests an important new line of investigation. The chemical is acetylcholine. It is discharged into the body by the nervous system and is thought to be the means by which nerves influence certain types of body activity. This chemical can cause cancer in

mice, rats, dogs, guinea pigs and fowl. Normally this chemical is destroyed as fast as it is set free in the body. It was found that prolonged injections of this chemical, given to learn more of its effects, resulted in the development of cancer. This discovery suggests that one cause of cancer may be the failure of the body in some cases to destroy acetylcholine rapidly enough. Further study of the rate at which this chemical is destroyed apparently is needed.

Two new possible substitutes for morphine which may free man from drug addiction, were announced by Dr. Nathan B. Eddy, of the University of Michigan, at the meetings of the federation. The new substances are: (1) methyldihydromorphinone, a substance derived from morphine, and (2) a synthetic chemical made from carbazole, a coal tar product. The promising substance derived from morphine, methyldihydromorphinone, has been given, to relieve pain in place of morphine, to between 800 and 900 patients at hospitals of the Massachusetts State Department of Health, hospitals of the U. S. Public Health Service and at clinics in Ann Arbor. Because the conditions from which these patients suffer vary so greatly, it is difficult to arrive at an exact knowledge of the value of the new drug. Encouraging from the standpoint of the fight on drug addiction is the report that it is not necessary to increase the dose of this new drug. The same amount continues to relieve pain after many doses have been given as was effective in the first dose. The synthetic drug derived from carbazole controls pain as well as codeine does, but it is rather toxic. The chemists think they can remove the part of the synthetic drug that produces these toxic or poison symptoms without reducing its pain-relieving property. It has not yet been tried on man, so no one knows yet whether or not it is habit-forming.

FIRST experiments on the dangerous cumulative effects of lack of oxygen for short periods such as in frequent short flights at high altitudes were reported by Captain H. G. Armstrong, Medical Corps, U. S. Army. Pilots do not get acclimatized to high altitudes as mountaineers do. Lessons learned from mountain climbing expeditions can not, therefore, be applied to high altitude aviation. Captain Armstrong's findings explain why pilots on commercial airplanes complain more and more of chronic fatigue even though they only fly at high altitudes for an average of 3 hours a day. The reason is that the effects of short periods at high altitudes pile up and in time the combined effect may produce dangerous lack of oxygen in the tissues. Rabbits, which can stand altitude one and a half times higher than man, did all right for the first two weeks of daily four-hour "flights" to 18,000 feet, which would correspond to about 12,000 feet for man. After the two weeks, they suddenly began to deteriorate, losing weight, becoming anemic, paralyzed and most of them dying by the fourth week. Even if engineers could find a safe, comfortable way to supply pilots and passengers with oxygen for high-altitude flights, they would not have entirely solved the problem and removed the danger. Captain Armstrong found that while rabbits could go to an average altitude of 38,000 feet without oxygen, many were dead at an additional 12,000 feet even when breathing essentially pure oxygen.—JANE STAFFORD.

A STAR GROUP OF A NEW TYPE

THE current issue of the Harvard Observatory *Bulletin* describes a hitherto unknown gigantic star-cluster, unlike any known class of cosmic systems, possibly a member of a whole family of such star clusters previously unsuspected in the universe. Dr. Harlow Shapley, director of the Harvard Observatory, who announced the find, said that the egg-shaped group is located in the southern constellation Sculptor. Because its light is extremely faint, only the most powerful telescopes can detect the individual star members. Discovery of the group was largely a matter of good luck. It was the fact that an unusually sensitive photographic plate happened to be exposed on Sculptor on a very clear night. A plate was exposed at the South African observation station of Harvard University, at Bloemfontein, for three hours through a 24-inch refractor telescope on September 25, 1935. A check through Harvard's library of star photographs showed that the group also appeared on long-exposure plates made in 1908, but only as a very faint patch of light, probably mistaken for general background unevenness or a faint blotch in the photographic emulsion.

Many characteristics of the new cluster are similar to those of three entirely different types of stellar systems, the globular star clusters, the Magellanic clouds and the spheroidal galaxies. The Sculptor group differs markedly from each of these on many points, however, and thus may be representative of a heretofore unknown class. Except for a small elongation in the east-west direction, the cluster appears roughly globe-shaped, and its individual stars can be seen and counted easily on the best photographs. They are arranged fairly compactly at the center of the group with the space between each star increasing fairly regularly toward the cluster's rim. The very brightest stars in the system are only about the eighteenth magnitude, extremely faint, inasmuch as the naked eye can detect stars only up to about the sixth magnitude. In general the brighter stars seem to be bunched more closely in the center, although there is no nucleus to the cluster nor any outstanding nuclear stars. Off-center clusters, cloud-like formations or other irregularities which would spoil the system's marked uniformity are also absent. About 10,000 stars are in the group with magnitudes between 18 and 19.5, according to preliminary estimates. Astronomers have no idea how many fainter stars it may contain. Despite this tremendous number of stars, the cluster yields surprisingly little total illumination and it is thought that some unusual physical characteristics of the stars, or of the group, cause this low brightness. This conjecture substantiates the suspicion that the cluster may be typical of a large family of such objects scattered throughout the universe whose low luminosity has heretofore concealed them.

Most probable of the conjectures offered concerning the nature of the cluster, in the light of evidence so far uncovered, is the theory that the stars may have an absolute magnitude of minus 1.5, about that of the brightest stars in the globular star clusters. Proof of this, of course, must await the discovery of variable stars in the group, but if the assumption is correct, the cluster is about 250,000 light-years away and has a diameter of about 6,500 light-years. Under these conditions, Dr. Shapley stated, the body could be described in one of three ways. (1) As a super-globular cluster more than 10 times the average size for this type. (2) As a Magellanic cloud but without the super-giant stars, clusters, irregular structures and luminous diffuse nebulosity which typify these systems. (3) As a nearby sparse spheroidal galaxy of unusually low surface brightness and also unusual in that its members can be distinguished from each other.

Inasmuch as the dimensions of the new cluster are still indefinite, other guesses concerning its nature may be nearly as valid. Other measurements, for example, might identify it as an unusually uniform and stupendous spheroidal galaxy of very low surface brightness, or as a particularly rich cluster composed entirely of dwarf stars, or possibly as a super-galaxy made up of thousands of highly condensed spheroidal galaxies but having some 10 times the population of any such group previously known. Whatever the assumption, however, the cluster is so markedly different from any other known star system it probably represents a previously undiscovered classification.

ITEMS

A SIX HUNDRED AND TWENTY-FIVE FOOT vertical antenna is being built at Schenectady to serve as the transmitting antenna for Radio Station WGY, powerful General Electric broadcast center. Resting its weight of 500,000 pounds on a porcelain insulator but 20 inches in diameter, the antenna resembles the 718-foot tower erected for Station KDKA in Pittsburgh several months ago. Instead of tapering at the top like the conventional tower, it tapers at the bottom to rest on the insulator. With the ground system and moorings for the guy wires holding the tower in place, the antenna occupies 20 acres of land. The antennae will be operating in 30 days, it is stated.

RECOMMENDED specifications, tolerances and regulations for all sorts of commercial weighing and measuring devices are listed by the National Bureau of Standards in a new handbook. Designed to eliminate from use weighing devices which are false or do not keep proper adjustment reasonably permanently or will facilitate fraud, the handbook lists recommendations made by the National Conference on Weights and Measures at its conference at the bureau in 1937.

DR. ARNO C. FIELDNER, U. S. Bureau of Mines, reviewing the state of the fuel industry in an address at the University of Maryland, states that nothing now known can be substituted for metallurgical coke, despite the growing use of fuel oils and natural gas. Coal, once supplying 89 per cent. of the country's fuel energy, and now giving 50 per cent., will in the future again supply most of our fuel energy, for our coal reserves greatly exceed our petroleum reserves. Gasoline from coal, ingenious though the Bergius and Fischer processes are, is thermally inefficient, requiring four tons of coal to make one ton of gasoline. Thus, gasoline should not be made from coal until all natural supplies of petroleum are exhausted.

DEEP, well-like holes in glacial ice, sometimes extending downward ninety feet, are caused by black bodies on the ice surface, says Dr. Fritz Tollner, glaciologist of Vienna, whose studies show that sixty per cent. of the sun's radiation can penetrate to a depth of ninety feet in the ice, when dark minerals are on the surface. Skylight, as well as direct sunlight, can melt ice under black bodies. Kryokonit structures, as these ice wells are called, can be made at will by placing dark substances on the ice. Ice structure, in addition to black materials on the surface, is a factor in their production, and this structure is prevalent in the Arctic ice, but not in alpine ice.

FLUORINE gas, corrosive vapor that dissolves even glass, given off in quantities by Iceland's subglacial volcano, sickens sheep and men in its vicinity, reports Dr. H. Vigneron, writing in the journal, *La Nature*. Lesions of the membranes of the nose and mouth are caused by the gases. Acting like a giant calorimeter, or device for measuring the heat given off by a fire, Vatnajökull, the crater under the ice, supplies geologists with a rather accurate measure of the energy of a volcanic eruption. From the amount of ice melted away from the Icelandic glacier, they can tell quite closely the amount of heat given out by the volcano. To date, this eruption has melted several cubic miles of ice. Now, it is becoming quiescent, but, judging from the past behavior of the crater, another eruption is expected in about 1945–50.

WEDDELL SEALS, rarest swimming mammals in museum collections, killed in the Antarctic by Admiral Richard E. Byrd's most recent expedition, have been placed on display at the Field Museum of Natural History, Chicago. Reaching a length of nine feet, and weighing up to 900 pounds, the Weddell seal, only mammal except the whale found in the Antarctic, is seldom seen in museums. The Field Museum collection is probably the only habitat group of Weddell seals anywhere. Mounted by staff taxidermist C. J. Albrecht, and displayed in an "environment" prepared by Arthur G. Rueckert, the seals are arranged to appear "at home" in the museum case. Creeping with extreme difficulty and violent wormlike undulations, the Weddell seal goes inland as much as eight miles during the Antarctic summer, when the 65-pound, open-eyed young are born. Nourished by its mother's milk, the young Weddell seal gains as much as seven pounds daily, and after three weeks or so is able to go "on its own," its woolly first coat replaced by a sleek fur of gray or brown with irregularly-placed spots of other colors.

SCIENCE NEWS

Science Service, Washington, D. C.

PEKING MAN

MAN and his kindred among the animals, in all their forms and relationships, were discussed this week at simultaneous meetings of the American Association of Anatomists and the American Association of Physical Anthropologists, at the University of Pittsburgh. Professor Franz Weidenreich, of Peiping Union Medical College, delivered an address, on Thursday evening, on "Peking Man and His Significance for the Problem of Human Evolution."

Recent though the discovery of Peking Man fossils has been, the researches of Professor Weidenreich and his colleagues have already disclosed many significant facts about this ancient branch of the human race in Asia, both about its physical characteristics and its way of living. A condensed summary includes the following points: Peking Man was one of the most primitive of ancient human beings, perhaps the most primitive; his skull was more "low-browed" than that of Neanderthal Man, though in other respects it was rather similar; his lower jaw and teeth had both human and ape-like characters; he walked fully erect like a man, not stooped like an ape; two recently discovered thighbones, though broken, indicate a possible height of five feet four and a half inches. This is a good human stature, especially since these thighbones may have been those of a woman; animal fossils found in the same caves with Peking Man's remains show that he lived on earth during early Ice Age times, probably hundreds of thousands of years ago; he could fashion rough stone tools, and he knew the use of fire; he was probably a cannibal.—FRANK THONE.

A PROTEIN FRACTION OF THE TUBERCLE BACILLI

THE feat of using two chemicals obtained from tuberculosis germs to make animals give a positive tuberculin test, even though they are not tuberculous, was reported by Drs. Florence R. Sabin and Austin L. Joyner, of the Rockefeller Institute for Medical Research, New York, at the meeting of the American Association of Anatomists, in Pittsburgh. The research, which is part of the mass attack on tuberculosis launched by the National Tuberculosis Association and leading research institutions, brings investigators one step further in understanding how the tuberculosis germ causes disease. They hope this means also that they are one step closer to final conquest of the white plague.

The tuberculin test, familiar to thousands of parents and school children as a routine measure for detecting early tuberculosis in the children, is accepted as giving indication of the presence of living tuberculosis germs. It has been possible to make animals such as guinea-pigs susceptible to tuberculin, even though they have no tubercle bacilli in their bodies, by injecting the protein fraction of the tubercle bacilli. Enormous quantities of this protein material, however, and much time are needed to produce this result.

Drs. Sabin and Joyner reported that they have found they can produce the same response in non-tuberculous guinea-pigs very much faster if they inject a mixture of the protein from the bacillus with a fat-containing phosphorus substance also obtained by chemical breaking down of the tubercle bacillus.

The chemicals used in this work were obtained from living tubercle bacilli in the Yale University laboratories of Dr. R. J. Anderson. Dr. Anderson has obtained many other chemicals from the tuberculosis germs. Dr. Sabin by injecting each of them alone and in combination into guinea-pigs, hopes eventually to learn which chemicals are responsible for the different symptoms of tuberculosis, such as the fever, the cheesy masses in the body tissues, called tubercles, and other symptoms. She even hopes to be able to produce complete germ-free chemical tuberculosis in the animals. The great hope is that when all this has been learned, it will be possible to find ways of negatizing each of these symptom-producing chemicals—in other words, to have one or more specific chemical remedies for curing tuberculosis.—FRANK THONE.

THE ORIGIN OF STELLAR RADIATION AND ENERGY

OUT of the nuclei of atoms and their study by means of atomic bombardment machines is coming knowledge which may help solve some of the baffling problems of astronomy. A new hypothesis on the manner of origin of stellar energy and radiation—among the most difficult of all puzzles of the astronomers—is suggested in the current issue of the *Astrophysical Journal* by Professor Georges Gamow, authority on nuclear physics at the George Washington University.

It has been customary to consider the temperatures of a star's interior as mounting to staggeringly large values deep beneath the surface. The steady rise of temperature, with increasing depth, would lead to rapidly increasing rates of nuclear reactions, so that the main energy-production should be concentrated in the center of the star. But this picture led to some contradictory consequences. The giant star Capella, for example, should have had a central temperature and density lower than the sun. As a result, the energy production in Capella should have been very much smaller than that of the sun. In contrast, Capella's energy production is known to be a hundred times larger than the sun's.

By Professor Gamow's new hypothesis the nuclear reactions which give rise to stellar energy occur at some favored resonance energy value which he tentatively sets at about 10,000 electron-volts. Thus all the energy production of the star will not occur at the center of the star, as in the former concept, but in a spherical zone some distance from the center where the temperature reaches the selective value. Inside this zone, or shell, the temperature would remain constant and the energy production would be negligible.

Professor Gamow points out that as the star gradually burns up its hydrogen, its chemical composition changes and the radius of the energy-producing shell will also change, resulting in a slow change in energy production. These slow changes in stellar energy with the age of the star would be in accordance with known observations. The new Gamow hypothesis also removes the paradox over Capella, already cited. Dr. Gamow writes: "It is now clear that for Capella, which has a radius about ten times larger than that of the sun, the selective temperature will be reached at much larger distances from the center than it will be for the sun. Consequently, the total energy production, which can be shown to be roughly proportional to the square of the radius of the shell of Capella, will be considerably larger than that for the sun."

A NEW VACUUM TUBE FOR USE IN TELEVISION

A KEENER "eye" for television cameras in the form of an extremely ingenious vacuum tube has been devised by Philo T. Farnsworth, active in television research in Philadelphia. Its great sensitivity to light will facilitate out-of-doors television for such events as parades or athletic contests and it will also permit more normal illumination in studios, largely obviating the glaring lights now used.

The invention promises to bring to television a device comparable with the "high-speed" cameras of photography. Moreover the new television camera permits what might be called "long exposures" on dark days. The "heart" of the new Farnsworth tube is known as the image grid. This is a piece of metal foil perforated by small holes to the extent of 160,000 to the square inch. On one side of this special metal foil, with its almost numberless perforations, is placed an insulating material, and upon the insulating material equally numberless little islands of photoelectric sensitive material. The image grid is placed in a suitably shaped vacuum tube, with its photoelectric sensitive side towards the window. In the neck of this tube is an electron gun. The optical image is focused, by means of a lens, upon the photoelectric sensitive side of the image grid. Each island emits electrons proportional to the amount of light falling on it, and in so doing the island becomes positively charged. The electron gun, in scanning, moves its beam over the back of the image grid in an ordered manner, spraying electrons upon the back of the image grid. The beam of the electron gun is deflected in scanning in the usual manner.

Consider a single island with its positive charge due to the light falling on it. As the beam of the electron gun falls on the back of this particular island, the positive charge draws great numbers of electrons through the small holes surrounding that island, and the increased number drawn through the holes is always proportional to the charge, and hence the light falling on that island. Thus the charge on the island acts like a valve, permitting an increased flow of electrons from the back. In front of the image grid, in the tube, is placed a coarse meshed screen, known as the signal screen. Through a suitable potential, the electrons which passed through the holes are drawn over to the signal screen, where they go to make up the signal current. Not only does the charge on the island act as a valve, as it were, to permit the passage of electrons through the holes from the rear, but enough electrons are also permitted to pass through to neutralize the charge and make the island ready for the next scanning.

Those familiar with radio will recognize here the principle of the triode tube, since the image grid island acts as the control grid, the back of the image grid as the cathode, and the signal screen as the anode. The discharge of the island itself may be likened to the grid leak in the triode tube, and since this grid leak can be controlled in the Farnsworth tube, another interesting and valuable phenomenon is encountered. It must be remembered that in television the complete picture is scanned or gone over, thirty times a second. Actually in modern interlaced scanning sixty half pictures are scanned per second. This means that the time for scanning of each island is of the magnitude of a millionth of a second. Using the "grid leak" of the tiny triodes in the television tube it is possible to regulate the charges built up on the little photoelectric islands from one scanning to the next, so that an optimum amount of light is always used. This is equivalent to increasing the exposure time in a photographic camera on a dark day, or under other poor light conditions. In the television tube, of course, some sharpness is sacrificed when long exposures are obtained. But, in contrast, the method permits television scenes in light so poor that even high speed photographic cameras can not function. What the new television camera does is to permit exposures up to one sixteenth of a second, if necessary, instead of the millionth of a second obtained in previous television devices.

THE MEETING OF WESTERN GEOLOGISTS

TITANOTHERES and submarine canyons, landslides and borax mines, shifting continents and retreating glaciers were among the many subjects scheduled for discussion by Pacific Coast geologists at the meeting of the Cordilleran Section of the Geological Society of America recently held at Stanford University. Beginning their sessions with a speech by Dr. Ray Lyman Wilbur, president of Stanford University, geologists, mineralogists, paleontologists and experts in many other lines of work related to geology listened to specialized papers.

SLOW GROWTH, accompanied by much local bending and breaking, characterized the building of the ancient mountains in the southern Sierra Nevada in Nevadian time, perhaps 150,000,000 years ago. The slow growth of the mountain masses, the changes in the rocks because of heat and pressure, and the local variations in the structures were described in detail by Dr. Evans B. Mayo, whose field researches have been financed by the Geological Society. Later motion in the same areas is being determined by studies of the remains of extinct volcanoes.

DISCOVERY of a new canyon, half as deep as the famous Grand Canyon, but buried under a mile of water off the

California coast was reported by Dr. Francis P. Shepard, of the University of Illinois. Dr. Shepard worked aboard the Scripps Institution of Oceanography research ship, the *E. W. Scripps*. The half-mile deep break in submarine rocks was discovered while on an exploratory cruise.

DR. HOWEL WILLIAMS, volcano expert of the University of California, reported that seemingly-mysterious mile-wide craters, associated with volcanic regions, were caused by the shifting of melted rock under the surface, causing cave-ins of the walls of groups of small craters. Sometimes the molten rock is thrown out of the craters in fragments, as happened when the volcano Krakatau blew up; other times the lava drains off from lower levels, as has occurred at Kilauea.

SAND BARS and lava flows of an age before life appeared on earth, twisted, broken, heated, the rocks altered, but their record still readable, were described by Drs. John H. Maxon and Ian Campbell, of the California Institute of Technology. Under the auspices of the Carnegie Institution of Washington, the two geologists read the partly-erased record held in the rocks and learned not only of the original structure, but of the many periods of heating, breaking and bending which the rocks have undergone.

THAT the contorted rocks of the Panamint Valley, gold-bearing waterless region bordering Death Valley, were caused by the well-known geologic processes of folding and faulting, was reported by Dr. Richard H. Hopper, of the California Institute of Technology. The rocks were folded, then broken, and later filled with molten material which came up from deep in the earth. Recently, geologically speaking, more breaks in the rock occurred, diverting stream courses.

FOUR HUNDRED square miles of volcanic débris, 500 feet thick, that was melted soon after its deposition during the Pleistocene ice ages into a solid mass, were described at the meeting of the Cordilleran section by Dr. Charles M. Gilbert. Compressed while still hot by the overlying materials, the lower layers of ash were squeezed into a solid mass creating a formation technically named "welded tuff."

SURROUNDED by lava flows in the Nevada Desert, in the Steamboat Hills ten miles south of Reno, Nevada, a mass of rhyolite, a volcanic rock a few hundred feet in diameter, gives evidence of recent volcanic activity in that region. John A. Burgess, of the University of Nevada, related the story of the volcano, which erupted not much more than a million years ago.

DYNAMITING the floor of Yosemite Valley to make it tell its story, and the story learned from the seismic sounding of the valley, were described by Drs. Beno Gutenburg and John P. Buwalda, geophysicists of the California Institute of Technology. Two ice ages have left deposits above the ice-carved rock floor, with the present surface composed of materials laid down since the retreat of the most recent ice sheets.

ITEMS

MORE than 100,000 acres of wild forested lands belonging to the State of Prussia have been set aside as a permanent refuge for moose. The area lies in East Prussia, near the city of Königsburg. It has never been cultivated, and very little timber cutting has been done. Regulations are very strict. Not only are such obvious ill practices as lighting fires, cutting trees, and shooting game prohibited, but visitors are not even allowed to leave public roads and paths without special permit, or to bathe in streams and lakes, or to park automobiles or put up hammocks. Certain parts of the terrain are completely closed to visitors.

WARFARE against the Dutch elm disease has been made more difficult, and the eradication of the plague probably delayed, by three new discoveries: (1) The fungus that causes elm disease may remain dormant in some trees, not causing immediate appearance of the wilting, drying branches by which the malady is now diagnosed; (2) such infected but not dying trees may never become distribution foci of the epidemic, unless broken limbs should bring the infection to the surface; (3) the fungus can live and grow in trees after they have died. Scouts who have ready means for recognizing the disease now know that apparently healthy trees may still be harboring it. Hence checking of any suspected areas must be repeated again and again, probably for years. Removal of elms that are sickly, deformed, or otherwise of low value is now sought, even though the trees may not now have elm disease. Such low-value elms offer ready harborage and food for the elm bark beetles that carry the disease fungus, much as mosquitoes carry the germs of human malaria and yellow fever.

SHOWING three times as much area as ordinary lenses used in aerial photography, a new lens, named the metrogon, was recently designed by engineers of the Bausch and Lomb Optical Company. With older lenses, aviators had to fly higher to take in more area, and then were unable to get the desired detail in their photographs because of haze in the air. With the new metrogon, they can fly at lower altitudes to photograph the same area, avoiding much haze trouble. Designed to eliminate much of the distortion usually associated with wide-angle lenses, this new "eye" will show single railroad ties anywhere in a two-mile circle under the camera, when the plane is a mile above ground. The detail that can be recorded by the center of the camera's field is limited only by the ability of the film to record it.

DRS. FRED E. ANGLE AND WILLIAM H. ALGIE, of Kansas City, Kans., reported to the American College of Physicians that undulant fever, acquired generally from drinking raw milk from infected cattle, is probably more common than generally supposed. They found evidence of a mild chronic form of this condition in over one third of a group of 426 Kansas City school children. Tests made at the same time as those for tuberculosis showed a surprisingly large number possibly infected, and questioning of parents of these children showed that many of them complained chronically of nervous symptoms such as appear in undulant fever.

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SCIENCE NEWS

Science Service, Washington, D. C.

SOME REPORTS OF PAPERS READ AT THE RECENT MEETING OF ANATOMISTS

ISOLATION of an important constituent of the living substance, protoplasm, was reported to the meetings of the American Association of Anatomists held in Pittsburgh recently. This report was made by Dr. R. R. Bensley, of the University of Chicago. Living tissue was killed, frozen and dried, then subjected to extraction in salt solution and other chemical treatments. The material produced is jelly-like in appearance and consistency, and under the microscope looks like the connective tissue found beneath the skin, except that there are no cell structures in it. Dr. Bensley has named it Plasmosin.

THE human leg as a problem in mechanical engineering was presented before the meetings by Professor Herbert Elftman, of Columbia University. Professor Elftman has devised apparatus for studying the action of the various parts of our propelling machinery as the testing machines at the Bureau of Standards or in engineering colleges study the performance of electric motors or gasoline engines. Motion pictures taken at the same time as the tests make the mechanical records easier to understand.

THE brain has a definite "heat center" that responds to heating by speeding up breathing, starting perspiration, and initiating other physiological means for cooling off the body. Its existence and location were demonstrated to the anatomists by Dr. H. W. Magoun, of the Medical School of Northwestern University. In the experiments, Dr. Magoun applied electrical warmth to various parts of the brain of an anesthetized cat. When respiration speeded up, and the toe-pads showed signs of sweating, that was taken as an indication of stimulation of the heat center. This region that responds to rise in temperature lies on the underside of the front part of the brain, and partly on the underside of the midbrain. Normally, Dr. Magoun supposes, this heat center receives its stimulus from increased temperature of the blood. Heated environment warms the body, which in turn warms the blood, and when circulation carries it to the brain its increased temperature triggers the cooling-off reactions of sweating and faster breathing.

COLCHICINE, the growth-checking drug that has been used lately in a new method for controlling evolutionary development in plants, also has a powerful retarding effect on the growth of animal cells. It was used in checking the growth of one type of cancer in mice, according to Professor Alfred M. Lucas, of the Iowa State College. "Repeated treatment causes a primary regression (nearly complete) of the tumor, but some cells which are probably resistant remain. Test animals live longer than controls." The same drug was used on two-day-old chick embryos by Dr. George H. Paff, of the Long Island College of Medicine. It produced various abnormalities and retardations of growth.

FOUR ears, growing where normally only two would grow, was reported by Professor Ross G. Harrison, of Yale University, newly elected chairman of the National Research Council in Washington, D. C. Professor Harrison obtained his results through tissue-grafting experiments with early embryonic stages of salamanders. A part of the side of the head region was removed, and a piece of tissue from the abdominal region set into its place. Organ-forming influences from surrounding head tissues would cause the development of small but otherwise normal internal ear structures in this transplanted piece. If the head tissue that would normally form ears was removed in the operation, the only ears that developed were in the transplanted abdominal tissue. But if the head's own ear-forming region was left in place alongside of the transplant, then both transplant and normal head tissue form pairs of ears, so that the animal would finally develop with both pairs.—FRANK THONE.

DRUGS OF THE SULFANILAMIDE FAMILY

CONQUEST of influenza may be the next victory that will be chalked up to the credit of sulfanilamide, widely used chemical remedy that is already known for speeding recoveries from blood poisoning (septicemia), gonorrhea, gangrene, peritonitis, septic sore throat and other infectious ailments. This appeared from the report, given before the Dallas Meeting of the American Chemical Society, by Dr. M. L. Crossley, research director of the Calco Chemical Company.

Advising caution against translating immediately findings with animals into human benefits, Dr. Crossley nevertheless reported that a newly-prepared chemical relative of sulfanilamide showed "marked protective action against experimental influenza in mice. Should this compound," he declared, "prove effective for human use against influenza, it would mean that mankind at least has a weapon against a scourge such as the world-wide epidemic of influenza which occurred in 1918."

The new compound is 2,5-bis sulfanilamidobenzene sulfonic acid. It is considered the most promising of a number of new sulfanilamide compounds described by Dr. Crossley, because it appears to give 100 per cent. protection again streptococcus infections in mice as well as showing protective action against influenza in mice. "While sulfanilamide has been demonstrated to be a very valuable drug in medicine, it is far from being all-sufficient and the aim of investigators in both chemical and medical research is to find new compounds which will be more effective and less toxic than sulfanilamide," said Dr. Crossley, in presenting his report with Drs. E. H. Northey and M. E. Hultquist.

Dr. Crossley described new types of drugs of the sulfanilamide family which, in tests on experimental mice, have only one tenth the toxicity of regular sulfanilamide and from 5 to 6 times the potency. Ten times the amount of these drugs may be used with only the same toxic

effect, and the amount administered is many times as potent in killing infectious disease organisms.

The new improvements in sulfanilamide drugs consists of linking two or more sulfanilamide molecules into larger molecules. Several of the drugs described by Dr. Crossley consist of two sulfanilamide molecules linked together into a dumbbell-shaped larger molecule. One can think of these new drugs, Dr. Crossley indicated, as being derived from the parent sulfanilamide possessing attributes of the parent but having, in addition, some new, acquired characteristics. While sulfanilamide has been effective in treating bacterial infections, some of the newer drugs, derived chemically from it, appear also to have usefulness in combatting the virus diseases.—ROBERT D. POTTER.

THE AMERICAN POTASH INDUSTRY

How a dry lake bed in a California desert, and a mine in New Mexico where men work beneath an overlying blanket of water, have made the potash industry possible, was described at a special symposium at the meeting of the American Chemical Society.

Prior to the World War, Germany, with its great potash deposits at Stassfurt, monopolized the world's potash trade. These Stassfurt deposits, formed in prehistoric times by the evaporation of sea water which then covered the spot, have an origin comparable with the dry, desert-bounded Searles Lake at Trona, California. By drilling wells into the dry lake a strong brine is encountered which contains over 35 per cent. dissolved chemicals, said W. A. Gale, chemist of the American Potash and Chemical Corporation at Trona. The brine is rich in the salts of potassium and sodium and the separation of the various fractions by evaporation is one of the triumphs of American chemistry. The prior work in Germany was of little use in developing the present processes. The physical difficulty of founding a town of 1,800 workers in a desert region was no small feat in itself. The Searles Lake deposit at Trona furnished 40 per cent. of America's potash needs last year, according to R. W. Mumford, of the same company, another speaker on the program.

As auxiliary products the salt brine produces 40 per cent. of the world's consumption of borax and boric acid, together with substantial amounts of soda ash and salt cake. In the California brine wells the potassium chloride is obtained only after evaporation processes. In the New Mexico deposits, near Carlsbad, the potassium chloride is mined in operations which, in some ways, are a race against time. The urgency arises because the potassium chloride deposits lie beneath layers of water-bearing sand and gravel. If that water enters the potash mine, the operations will be abandoned because the potassium chloride is highly soluble in water. "Should water enter the mine through caving," said R. M. Magraw, of the Potash Company of America, "the damage will be to a property that would be exhausted in any event if no effort were made towards ultimate recovery."

The Carlsbad mine is worked at the 1,000-foot level, consisting of salt and other solutions immediately above the bed. The top 400 feet consist of porous water-bearing limestone, shales and clays. In sinking the mine shaft water was often encountered. In one case the flow was 1,000 gallons a minute. These leaks were stopped and the shaft lined with concrete to stay, permanently, the flow. Water pressure of 84 pounds to the square inch now exist behind the concrete walls.

Below all this water miners do their work, using mechanical techniques as much as possible. Large amounts of explosives are employed because of the toughness of the ore. Room and pillar mining is employed with the pillars still in place. Eventually the pillars may be "pulled," said Mr. Magraw, when the deposits have been completely exploited. But, until that time, they will remain untouched because of the danger of bringing down the overlying water-bearing deposits and, hence, ruining the valuable potash.—ROBERT D. POTTER.

ITEMS

HOT RIVER, draining Mammoth Hot Springs, thermal region in Yellowstone, carries away radioactive materials equivalent to 40 grams of radium a year (worth about $800,000 if extracted), according to Drs. Herman Schlundt and Gerald F. Breckenridge, of the University of Missouri. Draining the deeply buried rocks of some of their heat-producing radium content, these hot spring waters of unknown origin do not contain much radium per quart, but over a year's time the amount of radon, a radium by-product, removed, is very great. Other hot springs, outside Yellowstone Park, also contain radium, suggesting that chemical changes deep in the earth are substantially the same wherever hot springs occur.

MILLIONS of tons of spodumene, ore of feather-like, silvery lithium, lightest metal known, have been located in North Carolina, near Kings Mountain, of Revolutionary War fame, since the first discovery of the crystalline white mineral by Frank Hess, U. S. Bureau of Mines geologist, in 1936. Hundreds of thousands of tons stick up above the ground, where they can be cheaply quarried, and more lies near the surface, reports Herman J. Bryson, state geologist of North Carolina. These deposits are the largest known in the world, far exceeding the famous beds at the Etta Tin Mine, in the Black Hills of South Dakota, where single spodumene crystals 40 feet in length, weighing 80,000 pounds, have been mined. Lithium is used as a hardener in lead and aluminum alloys and in various medicines. Its compounds are used in pottery and glass manufacture, storage battery electrolytes, photographic processes, as a coloring agent in signal flares, and in several chemical processes.

A BIRD refuge, comprising some 57,000 acres, has been established in the marshy delta of the Volga River. Here, vast stretches of wetland vegetation offer shelter to tens of thousands of birds, including geese, ducks, cormorants, pelicans, herons, egrets, gulls, terns and other waterfowl, as well as many species of songbirds, owls, hawks, etc. Mammals are comparatively rare, and there are not many reptiles. The region offers unusual opportunities for the scientific study of birds, and an ornithological research station is part of the regular establishment. Great numbers of birds have been captured, banded and released.

SCIENCE NEWS

Science Service, Washington, D. C.

THE ENERGY USED BY PLANTS

THE world's total working capital—the food which we need for carrying on the world's work—depends on a process which, under present-day conditions, is only one half of one per cent. efficient. Such is the verdict of those who have measured the efficiency with which green plants manufacture sugar from carbon dioxide and water in the presence of sunlight.

That process, photosynthesis, is the primary means by which food which plants and animals require is manufactured. Yet photosynthesis, which is carried on in the green portions of all plants, makes use of only a tiny fraction of the energy from the sun which strikes the plant. This half of one per cent. efficiency compares unfavorably indeed with the 33 per cent. thermal efficiency of some modern steam engines and the slightly higher efficiency of the turbine. But the plant's sugar factory is shown in a better light when it is realized that the object of photosynthesis is not to do work, but to manufacture food.

Calculations by Professor Edgar N. Transeau, of the Ohio State University, indicate that the energy that will come from the corn crop now being planted will represent barely more than half of one per cent. of the energy contained in the sunlight which will strike America's cornfields during the hundred days from June to September when the corn is growing. Similar figures have been derived by Professor Walter Noddack, of the University of Freiburg, who made measurements on a large scale with various types of grasses.

More than the half of one per cent. is actually used by the plants in photosynthesis, but the excess goes to the manufacture of sugar which is burned immediately by the plant to provide some of the energy for growing and carrying on its life business. Only 33,000,000 of the 2,043,000,000 calories of energy that fall on a single acre of corn between June and September are used in the manufacturing process of the plant. Two hundred pounds of sugar is the daily output of Professor Transeau's acre, but only a fourth of the sugar made is still available by the time the corn plant has become large enough to harvest. By far the larger part of the energy which a plant absorbs from the sun's rays is used for carrying on other functions of a growing organism.

The water used by the acre of corn during the summer would cover the acre to a depth of 15 inches if it were not absorbed by the soil and if it were not otherwise lost. Actually 910,000,000 calories, a little more than 45 per cent. of the energy reaching the plant from the sun, is absorbed in order to evaporate the 408,000 gallons of water. The water is evaporated in the essential process of transpiration by which oxygen formed as a by-product of photosynthesis is eliminated. Fifty-four per cent. of the balance of the heat from the sun is of no use to the plants.

Plants operate at the maximum efficiency possible today, according to Dr. Earl S. Johnston, of the Smithsonian Institution. But they could operate more efficiently if they had more carbon dioxide available. At one time, during the Coal Age, when plant growth was luxuriant, the earth's atmosphere may have been richer in carbon dioxide and the plants of that day consequently more efficient. Professor Noddack measured the amount of energy used by a plant by calculating the amount of energy required to manufacture sugar by photosynthesis and then determining the amount of sugar that a group of plants manufactured during a given period of time. A sensitive electrical device was meanwhile registering the amount of light that fell on the plants.—LEONARD H. ENGEL.

SORBITOL

FROM the cornfields of America comes a chemical which helps to bind books, aids in printing, softens leathers and which is being investigated as an agent in cigarettes and as a food for diabetics. These uses and others have been found for sorbitol, made from corn sugar and once a rare chemical, according to a report made by R. M. Bashford, of the industrial chemical department, Atlas Powder Company, Wilmington, Del., to the recent meeting of the Fourth Annual Chemurgic Conference at Omaha, Nebraska. The conference, sponsored by the National Farm Chemurgic Council, presents a summary of the newest progress of scientific research in seeking to find new industrial uses of the products of agriculture.

Starting with corn sugar as the base it is possible now to make, on an industrial scale, the complex substance sorbitol which chemically is a complex type of alcohol. The outstanding property of sorbitol, Mr. Bashford indicated, was its ability to retain moisture and hence it finds usefulness in many articles which must remain in their original condition as long as possible. Thus sorbitol is used as a conditioner for glues in book-binding. In the same way a glue-sorbitol-glycerine mixture is used to give longer life to printers' inking rolls.

Other uses cited are: Impregnation of coating paper and fabrics where resistance to oils and gasoline is essential. In the textile field for preventing loss of fiber strength due to decrease in moisture content. In the tobacco industry where it is tested (but not as yet used) as an agent preventing the drying out of tobacco. In the leather industry sorbitol preserves the desirable "hand" and softness because it does not evaporate or volatilize. Sorbitol has been favored in Europe for several years as a diabetic food. In America, Dr. E. S. West, of the University of Oregon, and Dr. C. J. Carr, of the University of Maryland, have made extensive studies of its toxicity, which indicate that its non-toxic properties in reasonable amounts are less than glycerine or cane sugar.—ROBERT D. POTTER.

THE MANUFACTURE OF SULFAMIC ACID

CHEMISTRY, by a new process, is now able to make cheaply and in vast quantities an acid from which can be made a unique flameproofing chemical. The chemical,

known as ammonium sulfamate, does not change the appearance or feel of fabrics or paper impregnated with it. Moreover, it is not affected by dry cleaning methods so that it will safeguard draperies, upholstery and other household furnishings during their lifetime. The parent raw material of the flameproofing chemical is sulfamic acid which, while known for more than a hundred years, has previously been made only by costly laboratory processes. Thus its flameproofing ammonium salt was too high-priced to be readily available to most people.

That a method for the large scale production of sulfamic acid has now been devised and put into operation, was reported by Martin E. Cupery, chemical engineer of E. I. du Pont de Nemours and Company, at the recent meeting of the American Chemical Society at Dallas, Texas. Sulfamic acid is made from urea and fuming sulfuric acid by the new process which, by one of the coincidences of science, has almost simultaneously appeared in Germany and in the United States independently. The new large-scale commercial method of making sulfamic acid, according to Mr. Cupery, has made available for many uses a new industrial raw material. As prepared, it is a colorless, crystalline substance looking something like the naphthalene of moth balls but without the odor, for sulfamic acid is odorless. A particularly useful property of sulfamic acid is its inability to take up water. Because it is non-hygroscopic this very strong acid can easily be shipped and stored without danger of wetting. However, the salts of sulfamic acid, of which the flameproofing chemical is only one, are soluble in water with one exception. Immersion, in fact, is the way the flameproofing chemical is applied to fabrics or paper. For this reason the materials flameproofed can not be washed without destroying the fire-combatting effects. While this may limit the utility of the chemical for some clothing, dresses and suits which must be dry cleaned are potential sources of use, as are many articles in the home.—ROBERT D. POTTER.

SYNTHETIC GASOLINES

SYNTHETIC, "tailor-made" gasolines which the petroleum chemical industry will soon be producing in quantities of 550,000,000 gallons yearly, mark the fourth, and adult stage of this major industry.

Dr. Per K. Frolich, director of chemical laboratories of the Standard Oil Development Company, Elizabeth, N. J., in an invited report to the American Chemical Society, described the growth of these "tailored" gasolines which are now giving airplanes a 15 to 30 per cent. increase in power take-off and climbing, or a 20 per cent. reduction in cruising fuel consumption when compared with the best previously available fuels.

The growth of the petroleum industry, Dr. Frolich indicated, closely parallels that of the motor car. The first stage was straight distillation of gasoline from petroleum. Even as late as 1918 some 86 per cent. of the nation's gasoline was obtained in this way. Next came the methods of thermal "cracking" of oils so that high boiling point fractions would be split into others which came within the gasoline distillation range of temperatures. This process was an enormous help to the petroleum industry at a time when there was much more worry, than there is to-day, about the available oil reserves. By cracking, the yield of gasoline from petroleum was increased from 25 per cent. by older methods to 50 per cent. Half the nation's gasoline is made now by cracking. The third step consisted in adding extra hydrogen atoms under pressure to the gaseous elements of petroleum and hence obtaining gasolines. This was another major improvement which permitted still greater yields. Finally, is the stage of synthetic gasolines which have been produced to match the demands of improved motor car and airplane performance.

The addition of tetraethyl lead to gasoline to give it higher octane rating was the first phase of this "adult" side of America's petroleum industry. In 1937 66,000,000 pounds of tetraethyl lead were marketed. This is sufficient to increase the octane number of the 20,000,000,000 gallons of gasoline sold in the United States by some six or seven points. There is a definite trend toward higher octane number fuels, and Dr. Frolich pointed out that "as we are reaching these high levels, it is becoming increasingly difficult to continue the upward trend without departing from the petroleum industry's policy of not letting the consumer bear the burden in the form of added cost." This may mean that extra-price premium gasolines are here to stay, at least for a while.—ROBERT D. POTTER.

NEW FLUORESCENT LAMPS

A NEW type of electric lamp, that uses ultra-violet light and fluorescent chemical-coated walls to produce white or colored light with an efficiency ranging up to 200 times that of present-day filament lamps, has been announced simultaneously by the Westinghouse Electrical and Manufacturing Company and the General Electric Company. The new tubular fluorescent lamps were recently demonstrated before members of the New York Electrical Society, the American Institute of Electrical Engineers, and the Illuminating Engineering Societies. Ward Harrison, of the General Electric Company, and S. G. Hibben, of the Westinghouse Manufacturing Company, described the lamps at the meeting. One of the new lamps, Mr. Harrison claimed, produces the nearest approach to natural daylight ever achieved by any artificial illuminant.

Differing entirely in principle from existing types of lamps in general use, the new lamps convert invisible ultra-violet light into white or colored light through the phenomenon of fluorescence. The efficiency of the new bulbs is far higher than that of the incandescent lamp, one type of the new lamp producing 60 lumens of light per watt in the 30-watt size, while the equivalent standard bulb produces only three tenths of a lumen per watt. Efficiencies in terms of colored light have been stepped up in some cases as much as 100 to 1.

Fluorescent powders compounded and specially heat-treated hold the secret of the color-producing qualities of the new light sources. Within each tube is a trace of mercury, a small amount of argon gas at low pressure and a coating of fluorescent powders, selected and blended to produce the colored light desired. When current is applied, the argon serves as a "starter" and in a frac-

tion of a second a feeble blue light with a large component of invisible ultra-violet radiation is generated inside the tube. This radiation strikes the fluorescent coating and is re-radiated in the visible range of the spectrum.

ITEMS

ISOLATION of chemically pure crystals of vitamin B_6 was reported by Dr. Paul György, of the School of Medicine of Western Reserve University, to the recent meeting of the American Chemical Society. This part of the vitamin B complex cures a skin disease in young rats which occurs when the animals eat a diet lacking in vitamin B_6.

A REVISED circular containing computations and "corrections" that must be made in computing the heating value of different kinds of fuel gases has been issued by the National Bureau of Standards. Revised by E. R. Weaver, chief of the gas chemistry section of the bureau, the circular contains information making it conveniently applicable to a wider range of compositions of gases and conditions of testing. In issuing the circular, the bureau calls attention to the importance of the heating value of fuel gas, as that is an important factor in determining its usefulness.

"VEGETABLE SHEEP"—plants covered so thickly with long, white-woolly leaves that from a distance they look like grazing sheep on the hillside—are the newest additions to botanical knowledge at the U. S. National Herbarium. They are described through the agency of the Smithsonian Institution by Dr. S. F. Blake, of the Bureau of Plant Industry. The plants belong to the aster family, and come from the Santa Marta Mountains in Colombia, South America. The only "vegetable sheep" hitherto known were from New Zealand. Another strangely shaped plant from the Santa Marta Mountains is known as the "monk plant"; at a little distance, especially through a light fog, a group of them looks like an assembly of robed priests.

NORTH met South in an ancient cavern death-trap, where Ice-Age beasts perished and left their bones in great masses, near the site of the present mountain city of Cumberland, Md., as shown by investigations by workers of the Smithsonian Institution. Remains of northern creatures like wolverine and marten are mingled with those of southern animals like tapir and alligator. The West is represented with fossils of such prairie or plains animals as wild horses and coyotes. Notable were some enormous cats, as big as lions or tigers, and much larger than any modern representative of their tribe in the Western Hemisphere. Dr. C. Lewis Gazin, paleontologist of the Smithsonian Institution, interprets the strange intermingling as meaning that the natural trap stood open over a good many thousands of years, while changes in climate influenced shifts in types of animal population.

SCIENCE NEWS

Science Service, Washington, D. C.

ATMOSPHERIC TEMPERATURE AND PRESSURE

AT the concluding meeting of the American Physical Society, recently held in Washington, Dr. E. O. Hulburt, of the Naval Research Laboratory, Washington, D. C., reported that the fleeting rays of the setting sun are being used to study the temperature of the atmosphere at heights far above any possible balloon ascension.

Direct measurement of the earth's atmospheric temperature and pressure have been obtained up to heights of 13.8 miles (the National Geographic Society-U. S. Army Air Corps) in manned balloon ascensions. Unmanned, smaller balloons have reached about 19 miles, said Dr. Hulburt. Searchlights have been used to probe the upper air and their rays have been detected, photographically at night, up to heights of 17 miles. However, Dr. Hulburt indicated, exact values of atmospheric density have not been obtained beyond a height of 14 miles by this searchlight method.

By the new system sunlight is used. "As the sun sets the earth's shadow above the observer moves upward and the region of the atmosphere illuminated by the direct rays of the sun moves to high levels." At dawn, the reverse sequence occurs and the sunlight starts from high altitudes and gradually works down to the surface of the earth. Both dawn and dusk measurements were employed in the research. The study involved the measurement of the brightness of the zenith sky for about an hour after sunset and an hour before sunrise. From these brightness studies, plus the known intensity of sunlight and the laws of scattering of light by air, the density (or pressure) and the temperature of the atmosphere was determined. The temperature came out to be between −50 and −80 degrees Fahrenheit, from 8 miles to about 35 miles above the earth's surface. No important changes in upper air temperature were noted in tests running from October to April. "It must be remembered," Dr. Hulburt concluded, "that the results refer only to the atmosphere during conditions of twilight in a temperate latitude (Washington, D. C.). One would expect that the upper air grew warmer during the day and cooler during the night. However, the day and night change may not be very great."—ROBERT D. POTTER.

A NEW X-RAY TUBE ARRANGEMENT

A NEW and simple arrangement of x-ray tubes, which may ultimately reduce the cost of x-ray treatment in cancer therapy, was reported to the meeting of the American Physical Society by Dr. G. Failla, chief radiologist of the Memorial Cancer Hospital, New York City. The chief merit of the new system is that it uses existing apparatus and yet eliminates certain parts so that the cost of a superior x-ray therapy installation is cut. Moreover, the "life" of the expensive x-ray tubes has been materially increased.

Dr. Failla, who has served on international committees on x-ray dosage standardization, stated that the key point in the new, cheap installation is the use of two x-ray tubes working on alternating current. Part of the past expense of x-ray treatment has been the necessity of using rectifying tubes which turn the alternating current from high-voltage transformers into direct current for use in the tubes. By the new Failla set-up alternating current is employed and each tube works on a "half-wave" of the cycle alternately. One tube is placed below the material, or patient, being radiated, and the other tube above so that double the intensity is obtained. In tests a radiation intensity of 7,000 roentgens per minute has been obtained, as compared with the 50 roentgens per minute output of standard equipment. "The surprising thing," according to Dr. Failla, "is that the tube life with this arrangement is longer than usual. In the case of two such machines used at Memorial Hospital for the routine treatment of patients, one of the tubes has been in actual operation for over 3,700 hours, and is still in good condition. This is an important item, considering that each tube costs about $450."—ROBERT D. POTTER.

THE STUDY OF ARTIFICIAL EARTHQUAKES

A NEW way of mapping the bottom of the ocean has been devised. An apparatus will create artificial earthquakes on the ocean floor and record the vibrations of the underlying strata as a clue to their make-up. Kites and balloons will be sent below the surface of the sea to guide equipment to the bottom and to return it automatically for inspection when its recording task is done.

A mile-long cable, to which are attached dynamite charges, microphones, recording equipment and clockwork control mechanism, will be strung out along the bottom of the sea, guided only by the kite. The cable serves as the kite's tail. An oil-filled balloon will float the apparatus, freed automatically of ballast, to the surface at the conclusion of the experiments. Dr. Maurice Ewing and Allyn Vine, of Lehigh University, who have already conducted experiments with earthquake-producing equipment moored to a surface craft by means of a long cable, described their new plans before the recent meeting of the American Geophysical Union. Credit for the idea of using the oil-filled balloon as a means of returning the valuable apparatus and the records is given by the two investigators to Auguste Piccard, who is now preparing for bathysphere exploration.

The kite-and-balloon scheme has been tested in the swimming pool at Lehigh University by means of scale models and is expected to be applicable to any depth required for the ocean-floor studies. A balloon six feet in diameter and displacing about 100 cubic feet of water will be used with the full-sized equipment. Not only does this means of placing the earthquake-producing charges and recording apparatus on the bottom save the cost of the extremely long cable ordinarily required, but since the apparatus rests on the bottom free of any connec-

tion with a surface ship, the test equipment is free of vibration from surface waves. The earthquake-producing equipment, which they used off Woods Hole, Mass., last summer, consists of three charges of dynamite, microphones to pick up the vibrations of the ocean floor when the dynamite is fired, batteries and clockwork controls. The dynamite fire is controlled by clockwork, as is a release device which drops the ballast required to drag the equipment to the bottom when the charges have been fired.

THE FLOW OF LAVA

VOLCANOES do not pour their rivers of lava down the luckless countryside in a clear hell-broth that runs like water over Niagara to waste forests and plantations with flame. "No thin broth, but a very thick porridge," was the simile used by Dr. T. A. Jaggar, volcanologist who lives in a house on the edge of Kilauea's crater, speaking before the Washington meeting of the American Geophysical Union. Rivers of lava do not run; they creep. A mile a day was the speed of the lava flow that threatened the town of Hilo some time ago and had to be stopped by airplane bombs.

The forward creep of one of these streams of thick lava is an impressive and very strange thing to watch. As it is extruded from the volcano—usually from a crack on its side rather than from the crater—it oozes forth in one big stream. This breaks up into a large number of smaller streams that flow in close ranks side by side, like a hank of rope. This ropy type of lava is called by a name that originated in Hawaii, pahoehoe. As each streamlet of the pahoehoe pushes itself forward, it roofs itself over with a thick, solid crust, so that the entire stream comes to flow in a tunnel of its own making. Even the forward end of the lava is covered with a thin crust or membrane, which it constantly breaks through and as constantly re-forms. The moving tip of a pahoehoe streamlet Dr. Jaggar likened to an elephant's toe.

Dr. Jaggar stated that the stopping of the recent flow that menaced Hilo was not a military man's idea, nor yet his own inspiration. At first the proposal was to pack a lot of dynamite to the critical point on muleback, but a planter pointed out that bombing planes could not only find the lava tunnels much more easily in the dense forest but could attack them more effectively when found. Neither was the bombing attack conducted against the moving front of the lava columns. That would not have stopped them. In true modern air-warfare style, the planes struck at the base of operations—the heads of the lava streams just as they emerged from the slope of Mauna Loa. With 600-pound bombs of TNT they blasted in the roofs of the tunnels. This permitted the escape of the gases that were the principal source of heat for the lava. With their power supply thus cut off the streams were stopped at their source.—FRANK THONE.

A NEW WASHING PROCESS

CHARGES of electricity are being used in industrial operations for "washing" undesirable constituents from certain materials and for drying clay for use in making chinaware, according to a report given at the Savannah convention of the Electrochemical Society.

Applications of the fact that tiny colloidal particles, of which such substances as clay are made up, carry electric charges, lie at the base of the new procedures reported by a Japanese investigator and by an Ohio ceramics chemist. Carl E. Curtis, of the Simonds Worden White Company, Dayton, Ohio, explained that water with which clay is mixed in order to wash out the sand accompanying it when it is mined can be removed by running the water-and-clay mixture through a special piece of electrical apparatus. Since clay particles suspended in water have a negative charge they are attracted to and "electroplated" to a positively charged pole and are thus separated from the water suspension. This process leaves a clay product containing only 35 per cent. water, which is easily removed. In use abroad, it is compared with the ordinary drying and filtering procedures in wide use in the United States.

That undesirable colloidal particles can be "electro-washed" from a variety of materials by taking advantage of this same fact, that colloidal particles carry an electric charge, was reported by Sakuji Komagata, a chemical engineer of the Japanese Government, Tokyo. Application of the proper electric charge to the material causes the undesired particles to migrate to an electrically-charged point and thus to be removed from the material. The process has been successfully used in the manufacture of vulcanized fiber, pulp for power cable paper and condenser paper and photographic films and plates.

ITEMS

ASTRONOMERS will pay little attention to the solar eclipse that will darken the South Atlantic on May 29 of this year, according to Dr. Harlow Shapley, director of the Harvard Observatory. Shadowing only the far South Atlantic, where the sun at noon is close to the horizon, the path of totality will cross only a few insignificant islands, of which South Georgia is the largest. With no proper facilities for landing the ponderous eclipse cameras, and only a faint chance that the mist-shroud of the island will break during the eclipse, astronomers do not feel justified in sending an expedition to South Georgia Island. Several months of preparation, and the expenditure of thousands of dollars, are hardly worth while when the chances of seeing the four-minute eclipse are less than one in a hundred. Astronomers are looking forward to 1940, however, when an eclipse of the sun on October 1 will be visible in a narrow band from Colombia, on the west coast of South America, to South Africa.

A GERMAN firm has succeeded in plating iron with acid-resisting chrome nickel or chrome-nickel-molybdenum steels, necessary alloy in the prevention of corrosion in acid tanks. Only 10 to 20 per cent. of the relatively expensive corrosion-proof alloy is used to cover the iron base. Tanks have previously had to be made entirely of acid-resisting alloys. The alloy coating is intimately fused with the base metal, it is stated, one material for all practical purposes resulting from the coating process.

SCIENCE NEWS

Science Service, Washington, D. C.

PEKING MAN

CASTS made of the space once occupied by the brain, in the skulls of half-million-year-old Peking Man, show many remarkable ape-like features, despite the indubitable fact that this oldest inhabitant was definitely human. Some of these features were described recently by Dr. Franz Weidenreich, leader of excavation work in the Choukoutien caves near Peiping, in the annual James Arthur Lecture, at the American Museum of Natural History.

Dr. Weidenreich reported that although the volume of Peking Man's skull space is definitely in the human range and far above that of the apes, the distribution of that space is not in accordance with that of the present day. The arch of the cranium is very low, and the greatest breadth of the skull lies low and toward the rear. All of this minimizes the forebrain, usually considered to be the center of the higher, more intellectual part of the brain's activities.

Not only in bulk but also in detail was the forebrain of Peking Man less developed than that of modern human beings. The folds and furrows were fewer and simpler, more on the ape pattern than those of modern brains. Furthermore, the blood supply, traceable through the grooves in which the arteries fitted under the skullcap, was relatively scanty and not elaborately distributed. This again is an ape-like character; modern human cranial arteries that serve the forebrain are much more abundant and elaborately developed.

Peking Man's teeth, like his brain, are undoubtedly human, yet show some interestingly simian features. They are bigger and longer-rooted than modern human teeth, and there is no sign of reduction or degeneration in the wisdom teeth. The pattern of the grinding surfaces on the molars is complex, like that of ape teeth, in contrast to the relatively simple, cross-grooved pattern of teeth in modern man. Of especial interest is the total absence of dental caries, traces of pyorrhea, and other symptoms practically universal among present-day human beings and frequent even among more recent Stone Age races. Among the 148 teeth of Peiping Man thus far found, not one is defective.

FOSSIL LAND ANIMALS AND CONTINENTAL DRIFT

DRIFTING continents and great trans-ocean land bridges were not necessary to explain the distribution of life during the earth's past ages when coal was forming, according to Dr. Charles L. Camp, geologist at the University of California. Distribution of fossil land animals does not support the theory of continental drift, but strengthens the idea that the continents have always been land and the oceans always full of water.

To explain the distribution of plants and animals of past ages, geologists have evolved a number of theories: (1) That in early times there was only one continental land mass, which broke up. The fragments, gradually evolving into our present continents, drifted slowly around the earth, carrying with them the primal animals, ancestors of some of our present forms. (2) That there were great land bridges extending across the South Atlantic, over which animals and plants migrated from continent to continent. These bridges, according to theory, foundered into the oceans not so many millions of years ago. (3) That the continents have always had about their present shape and distribution, with occasional submergence of some low-lying areas, and uprais-ing of shallow sea floors to become land.

Discussing his evidence, gained from a study of the fossil land animals of the continental areas, Dr. Camp finds that they probably migrated from Eurasia to America over northern land connections, and that neither drifting continents nor land bridges in areas that are now deep sea are needed to explain their distribution. Using only large land animals, that can not swim long distances or be carried by birds or wind, as evidence, Dr. Camp solves the problem of conflicting evidence. Long ago it was shown that the plant and water-animal life of South America greatly resembled similar life forms in Africa, and on this resemblance many geologists contended for continental drifting and land bridges. Other geologists pointed out that birds can carry plant seeds, winds carry fern spores, and that water animals generally travel by swimming, needing no land bridges or drifting continents to explain their presence in Africa and South America.

Southern amphibians and reptiles, according to Dr. Camp's interpretation of the fossil evidence, came to the southern continents from the north, which, throughout much of geologic history, was an interconnected series of continents. Southern fossil types, then, came from the same place—the north—and did not cross over from one continent to another on land bridges, or drift across the Atlantic on a "footloose" continent.

A NEW RED PIGMENT OF THE LIVER

IT was reported at the recent meeting of the New York Section of the American Chemical Society that a new and yet unidentified, red pigment, which is a super heavyweight among the body chemicals of the higher animals, has been isolated at Yale University.

The red pigment, having a molecular weight more than 50 times as great as familiar hemoglobin in the blood, was found in a research seeking enzymes in horse liver. Dr. Kurt G. Stern, who reported the discovery, and Dr. R. W. G. Wyckoff, both of Yale, collaborated in the studies. "As far as we can tell," Dr. Stern said, "this red pigment is different from any other substance, from liver or from other sources, yet described." Chemically speaking, the new red pigment—having the enormous molecular weight of 3,000,000 to 4,000,000—has not yet revealed features which would permit its classification among any known class of chemical compounds.

The new substance was found as a by-product of re-

search seeking a pure solution of catalase, an important body enzyme. An air-driven ultra-speed centrifuge, whirling rapidly, was used to separate the liver red pigment from the brown catalase. The pigment is far larger, in its molecular size, than anything previously encountered in the bodies of higher animals. Only the copper-containing blood pigment of invertebrates, known as hemocyanine, may reach similar proportions. The biological function of the red liver pigment is yet obscure. But it is assumed that it is connected with the use of oxygen by the animal body because it can be reduced to a clear, colorless form. The red color, however, appears to be a property of the large molecule itself and not of an impurity. The molecular weight of catalase, the enzyme sought in the original research, was determined by the investigators to be between 250,000 and 300,000, or four times larger than hemoglobin, the respiratory pigment of red blood corpuscles.

INDUSTRIAL CARBON DISULFIDE POISONING

SIX new cases of carbon disulphide poisoning among workers in rayon manufacturing plants are reported in the forthcoming issue of the *Journal* of the American Medical Association. This insidious form of poisoning, wide-spread in Europe, has received little medical attention in the United States, according to Dr. Samuel T. Gordy and Max Trumper, who two and a half years ago urged a federal survey of the rayon industry. Such a survey is now being made.

This country is one of the largest rayon manufacturing countries in the world, having produced 290 million pounds in 1936. Of the 25 rayon factories, with 50,000 employees, now operating in the United States, 19 are viscose plants using carbon disulphide. For every three pounds of rayon produced, one pound of carbon disulphide must be used. In 1936 more than 33 million pounds of carbon disulphide was consumed by one large viscose plant.

The poisoning makes physical and mental invalids of those it attacks. Headache, stomach trouble, muscular cramps, motor palsies, wavy vision, irritability, horrible dreams, hallucinations, primary increase in libido and later diminution and loss of sexual function are some of the manifestations of the poisoning. Women are affected more often than men, the medical literature shows. The poisoning is of both the acute and chronic types. Tolerance is not established or rarely so. On the contrary there is increased susceptibility to poisoning on further exposure. The psychosis may pe permanent, they state. Until the introduction of artificial silk, the rubber industry was the principal origin of disulphide poisoning. That the condition is not more generally known of in the United States is strange. That industrial diseases have not had the study in America that obtains in many European nations where they are reportable and compensable, is a possible explanation. With the application of the new occupational disease compensation laws in many states, it is expected that more will be heard of this insidious poison.

A NEW PROCESS FOR COLOR PHOTOGRAPHY

A NEW color photographic process that would use a layer of differently dyed red blood corpuscles as filters for separating colors in order to record them on film has been patented by Chalmers C. Smith, of Glendale, Calif., and Ray H. Pinker, of Los Angeles.

Use of the corpuscles, the inventors claim, represents an advance over present color photography technique, which uses either a ruled screen or a layer of starch grains to achieve the color separation. Colored motion pictures and still photographs are all made essentially by using one or another means to separate the three primary colors that make up all shades and tints and to record them separately, then put them together again for viewing purposes. Practical development of the process might well mean a fundamental change in the technique of making colored motion pictures used at present. These are made by means of a triple-coated film, one layer with its associated filter being sensitive to one of the primary colors. This process has, however, serious practical limitations. The screen processes are not used in commercial color motion pictures because the starch grains and the rulings show in the enlargement thrown on the screen.

The red blood corpuscles of sheep, .003 millimeter across, are sufficiently small so that when enlarged 240 diameters in being thrown on a screen as in motion picture projection, they would still be less than a millimeter in diameter, a size small enough perhaps not to show. A further advantage claimed for the idea of using a corpuscle screen is that the corpuscles are more translucent than starch grains, cutting down the amount of light required for taking pictures, and are also more regular.

A HYDROPONIC FARM ON WAKE ISLAND

WAKE ISLAND, tiny dot of coral far out in the Pacific, is to be the site of the newest soilless "farm" for growing green vegetables according to the system originated by Dr. W. F. Gericke, of the University of California. With a total surface area of only half an acre, it is expected to supply the table needs of passengers and crews of trans-Pacific clipper planes that use the island as a way station on the long flight.

The "farm" will consist of a series of shallow tanks now rapidly being installed. These will be filled with water in which mineral fertilizer salts are dissolved in the right concentration to feed green plants. Over the tops of the tanks wire netting will be stretched, on which, supported in sawdust, excelsior, or other suitable material, tomatoes, peas, beans, carrots and other vegetables will grow, drawing their water and mineral nutrients out of the tanks in which their roots will be dangling.

Wake Island will represent the westernmost extension of Dr. Gericke's system of soilless farming, or "hydroponics." Similar set-ups of tanks for growing vegetables and flowers have been established under his supervision at a number of places along the Pacific coast of the United States, and recently the system has been extended to the eastern part of the country. Dr. Gericke has just returned from an inspection visit to hydroponic "farms"

in the East. He states that a number of European governments have expressed lively interest in his method of growing crops without soil.

Extensive experiments have been carried out with a large variety of economic plants, even including a full-sized banana tree. Results indicate that for the present at least profits can not be expected from crops consisting of dry seeds, like wheat and other grains, particularly when these also depend for their value on high protein content. It appears more profitable to raise plants in the fresh vegetable class, which have high water content and are valued mainly for carbohydrates, vitamins, attractive flavor and mineral salts. Tomatoes have thus far proved the most successful of hydroponic crops. The system is used either in greenhouses, or out of doors where the climate of growing season is favorable. In the continuously mild tropical climate of Wake Island, cultivation will be carried on entirely in the open.

ITEMS

THE first recorded case in which the substitution of heavy hydrogen, or deuterium, for ordinary hydrogen in a chemical reaction produces a color change, is reported in the *Journal of Chemical Physics*. Professor Victor K. LaMer and Samuel H. Maron, of Columbia University, describe their color-change experiments which are still in progress. It is well known that the substitution of a deuterium atom (D) for hydrogen atoms (H) in chemical compounds produces a material with different physical characteristics but, until the LaMer-Maron experiments, this change was never observable to the senses. In the tests the change from hydrogen to deuterium atoms produced a light yellow color in a previously clear solution. The chemicals involved in the tests were a solution of proto-nitroethane in heavy water and a compound made of barium, oxygen and deuterium.

SYPHILIS apparently afflicted almost half the Indians in some communities along the Potomac River. Displaying Indian bones marred by disease, before the Anthropological Society of Washington, Dr. T. D. Stewart, of the U. S. National Museum, raises the question: Where did syphilis come from? Prehistoric America has generally been blamed for giving the world this serious malady. Recent archeological discoveries in Maryland warrant reopening the question, and may lead to the opposite verdict, that white men from Europe brought syphilis to America. Possibility that the Maryland and Virginia Indians caught their disease from white men of Jamestown, or other explorers or colonists is pointed out by Dr. Stewart, who finds particularly significant the spreading of the disease through so many Indians in one group. This is the way the disease would spread, and it is curious that supposedly very ancient cases of syphilis in America have been single skeletons, or Indians of uncertain antiquity. Indian bones marked by ravages of syphilis have a characteristic spongy surface, which Dr. Stewart says was caused by inflammation of the covering membrane of the bone.

SCIENCE NEWS

Science Service, Washington, D. C.

CHECKING THE LUNAR THEORY

USING more than 250,000 punched cards, and six automatic computing machines, workers at Columbia University have solved an astronomical problem, in two years, which originally required thirty years for its manual solution. Fifty years ago Professor Ernest W. Brown, of Yale University, set out on his life work of checking the application of Newton's law of gravitation to determine the motion of the moon. Finally, after thirty years' work, he solved this problem which was first raised—but never solved—by Sir Isaac Newton in 1687. Since 1923 astronomers and navigators, throughout the world, have been using mathematical tables of the moon's position and motion, based on Professor Brown's long-extended work. But never, until the recent Columbia automatic calculations, have the involved and tedious computations been checked.

Professor Wallace J. Eckert, of Columbia, perfected, two years ago, the astronomical punch card system and the alterations of the computing machines. The method is an adaptation of the same system which is used by large companies, schools and the U. S. Bureau of Census in compilations of vast masses of data. Working for two years with lunar data, the machines show that Professor Brown's original work was correct to within one hundredth of a second of arc, which is the degree of accuracy originally desired by the lunar theory. The mathematics of checking the lunar theory, according to Professor Eckert, consists of substituting into differential equations the harmonic series which represent coordinates. The series expression for each coordinate consists of about 500 terms with coefficients of ten significant figures. The principal part of the machine computation consists of multiplying such series (of 500 terms each) together in pairs.

The machines are standard electric business machines such as used in large-scale bookkeeping and accounting. They were supplied to Columbia University by the International Business Machines Corporation through the cooperation of its president, Thomas J. Watson, who is also a trustee of the university. Only slight alterations were needed in these standard machines to adapt them for computing astronomical calculations. A computing bureau, for astronomers throughout the world, has been established at Columbia University, to be known as the Astronomical Hollerith-Computing Bureau, after Herman Hollerith, who in 1890 first applied the machines in analyzing the U. S. Census of that date.

AMERICAN PREHISTORY

DISCOVERY of strong evidence that America had two prehistoric waves of pioneers before the famous Folsom hunters is reported by the Southwest Museum. The discovery is pronounced to be "of major importance to American archeology." It is as surprising an addition to our prehistory as if two boats earlier than the *Mayflower* had been found bearing colonists to New England shores in our historic era.

A joint expedition of the Carnegie Institution of Washington and the Southwest Museum, led by M. R. Harrington of the latter institution, unearthed stone relics of the long-departed and long-lost Americans. Investigating the shore of a brackish pond in Lake County, California, where C. C. Post, of Berkeley had found spearheads of one of the oldest known cultures of America, new chapters of prehistory were opened out.

The surface layer, turned topsy-turvy by recent ploughing, contained spearheads, knives, drills and scrapers typical of the Folsom hunters. With such implements, Folsom Men killed the mammoth and giant bison and prepared the kill for food and clothing. The loosely estimated antiquity of this Folsom era is seven to twelve thousand years ago. With Folsom Man's handiwork the archeologists found quite different stone spearheads and other implements. These different tools have recently been turning up at Lake Mohave and another western site, leaving doubt as to whether people older than the Folsom hunters had or had not been found. Now, the mystery is believed to be solved, since digging into the Lake County site brought the Mohave type of tool to light in a camp deposit definitely below the Folsom tools—and therefore older than the Folsom tools.

There may have been, not merely one, but two kinds of primitive pioneers inhabiting America at the same time in those pre-Folsom days. For Mr. Harrington reports finding a new type of spearhead, which he calls the Borax Lake type, which was found buried at about the same levels as the Lake Mohave tools. Most surprising of all, was the discovery that below these relics lay still older weapons, made by people "as yet entirely unknown quantities in American archeology." These dawn men of America made crude and coarse stone implements, described as mainly large scrapers and hand axes which they clutched in the first, using no handle.

Finding the deep levels of the site thus undisturbed after thousands of years convinced Mr. Harrington that these unknown ancients lived about 13,000 B. C., or perhaps earlier. It is pointed out that "These are staggering figures to persons under the spell of the misleading implications behind the term 'New World,' but evidence is accumulating throughout the Americas that this hemisphere is no more new than its great western ocean is Pacific."

AN EXPEDITION TO THE TULAROSA BASIN

A "LOST WORLD" of a different kind, consisting of an island area of white sand on a surrounding "sea" of black lava beds, will be studied for evolutionary effects on its animal population by a Field Museum expedition headed by Dr. Wilfred Osgood. The region is in the Tularosa basin, a desert area of some 300 square miles in south central New Mexico. Dr. Osgood's companions will be Dr. Frank W. Gorham, of Los Angeles, and Walter F. Nichols, of Pasadena.

The animal population does not consist of fabulous surviving dinosaurs, but principally of small, mouse-like

rodents. The evolutionary phenomena of interest are not conservative survivals of old forms but the rapid development of new ones—"evolution while you wait," it has been termed. Of special interest is the fact that in the comparatively brief geological life of the white-sand "island" its animal population has become very pale-colored, while closely related forms in the surrounding black-lava region are very dark. It looks like a very good case of natural selection operating through protective coloration, for presumably animals that match their respective background colors have better chances for survival, while those with contrasting colors have been picked off more easily by hawks, owls, foxes and other predators.

It is the usual custom to collect animals of this kind by killing and skinning them. However, in order to insure their arrival at the Field Museum in absolutely fresh condition, with colors quite unchanged, the animals trapped by the present expedition will be sent back alive by airplane.

ROCK FORMATION FROM MOLTEN MAGMAS

GRIMY greenish-gray rocks, broken from the ice-carved, wind-swept slopes of an extinct volcano in the almost unexplored Raymond Fosdick Mountains of Antarctica, by Dr. Thomas C. Poulter, senior scientist of the second Byrd Antarctic Expedition, may increase our knowledge of how rocks are formed. Reporting the results of a study of these rocks to the Geological Society of America, Dr. C. N. Fenner, rock expert of the Geophysical Laboratory of the Carnegie Institution in Washington, finds that old ideas of rock formation need to be reviewed.

Until recently, it was believed that molten rocks deep under the earth's crust resembled basalt, a dark heavy rock, of which the Palisades of the Hudson, the Giant's Causeway in Ireland, the Devil's Postpile in California, and many other famous clifflike structures are made. As these molten rock masses came near the surface, certain compounds in them crystallized as the rock cooled, leaving other mineral compounds molten until further cooling took place, and changing, as cooling went on, the chemical composition of the remaining molten material.

According to this theory, which has received much support, alkaline materials should crystallize first from a molten rock magma, leaving it more acid than before. The rocks from the Antarctic, however, do not follow the theoretical rules of change, suggesting to the geophysicists that laboratory conditions do not duplicate field conditions very closely, and that tests should be made of the rocks themselves and their minerals, and not of laboratory specimens under simpler conditions than those existing in nature.

YARN FROM SOYBEAN

A JAPANESE company is preparing to start production this fall on a small commercial scale of another new synthetic fiber, produced this time by chemical means from the soybean, food plant grown widely in northern Asia and of increasing importance throughout the rest of the world.

Fibers and cloth derived from the soybean, the latest source for a flood of new synthetic fibers that is revolutionizing the textile industry in every country, are to be manufactured at a rate of 20 to 30 tons a day when the factory begins operations. Development of the process for converting soybean protein into fiber is credited to Ryojei Inouye, awarded recently the Fujii prize of the Physical and Chemical Study Council of Kyoto Imperial University, one of Japan's "big six" universities, for his accomplishment. The drive to produce the new material as soon as possible is admittedly inspired by German success with a process that makes a fiber containing 50 per cent. fish albumin and 50 per cent. cellulose and from an Italian method which turns casein into yarn.

Soybean cake, the material remaining after the oil is pressed from the plant in giant mills in Manchuria, is the starting point for the process. The soybean, object of intensive research in laboratories in nearly every country including our own, is the source for a wide variety of synthetic products. Aside from its uses in Asia as a food and for fodder for domestic animals, the plant has found application in the manufacture of paints and enamels, synthetic plastic, varnish, glue, printing inks, rubber substitutes, insecticides, linoleum, glycerine, flour, soy sauce, breakfast food, candies, roasted beans with a nut-like flavor and in other ways. The U. S. Department of Agriculture maintains a Soybean Experiment Station at the University of Illinois, one of whose research goals is the development of just such a process as is reported here.

THE SOUTH SEAS CLIPPER

THE seemingly never-ending saga of bigger and better airplanes added another chapter with the launching and first flight at Seattle of the *South Seas Clipper*, 72-passenger Boeing giant built for Pan-American Airways. Weighing 83,000 pounds loaded, the newest empress of the air is the first of six Atlantic-type clippers intended for service on Pan-American's coming transatlantic and U. S.-New Zealand services. All will be delivered by midsummer.

Said to be one of the finest craft of any type ever built, the new plane will carry 72 passengers by day or 40 by night a maximum of 4,000 miles at 200 miles an hour. Four new Wright Whirlwind 1,500-horsepower engines, the most powerful gasoline engines ever built and installed so as to be accessible during flight, power the clipper. A crew of eight will handle her. Five tons of mail and express can be carried by the double-deck liner. These decks will be linked by a spiral staircase in the best shipboard manner.

Its 159-foot wingspread necessitated final assembly out of doors. A special 15-ton beaching gear was required to haul it from the factory to the water's edge. Its tail surfaces alone have a greater area than the total wing area of many twin-engined transports now in operation. The new Boeing clippers, the first invasion of the company into the big seaplane field, are the third series of big boats placed into service by Pan-American on its lengthy overseas routes as traffic and mileage have grown during recent years. The first of the really big boats were the *Sikorsky S–42's*, now used on the main Caribbean routes and the run between New York and Ber-

muda. The second was the series of *Martin Clippers* that have been running like clockwork back and forth across the Pacific for more than a year. Big as this craft is, it is still a pygmy compared to craft now on the drawing boards and in the imaginations of engineers both of the operators and of the manufacturers. Designs for aircraft capable of carrying a hundred passengers at a load have been requested of leading builders by Pan-American and at least six designs are known to have been submitted. But to-day, and for at least a year or two to come, the 109-foot long, 28½-foot high liner is and will be empress of the air.

THE CAUSE OF CHRONIC GALL BLADDER DISEASE

GERMS of fairly ordinary types are the culprits that cause or at least pave the way for chronic gall bladder disease and they may be taken into account in treating the condition. Research showing this was reported by Drs. Martin E. Rehfuss and Guy Nelson, of Philadelphia, at the recent meeting of the American Gastro-Enterological Association.

Chronic gall bladder disease was produced in rabbits by repeated injections of small numbers of germs over a long period of time. The germs were obtained from the nose, throat, teeth and lower part of the digestive tract. They included staphylococci, streptococci and typhoid and colon bacilli. A streptococcus from the human digestive tract produced gall bladder disease in nearly half the animals in one study. In these animals changes in the gall bladder occurred similar to those found in human gall bladders removed at operation. In addition, the rabbits showed signs of kidney, heart and joint diseases, conditions which are being noticed more and more in association with gall bladder disease in human patients. In about a third of some 900 gall bladder patients, one of the doctors had noticed involvement of muscles, nerves or joints or impairment of heart and blood vessels.

Repeated attacks on the gall bladder by very small germ armies is enough to cause disease in this organ even if the germs are subsequently vanquished by the body and no trace of them found when the gall bladder is removed at operation. In a survey of over two thousand cases of its removal it was found that a little less than one out of every two removed on the operating table were infected. Cleaning up foci of infections in teeth, throats and elsewhere therefore becomes an important part of treatment for chronic gall bladder disease. Specially made vaccines have been used with unusual success at times in controlling these infections and the gall bladder condition. The diet of patients must also be watched to insure their getting enough vitamins A and D. These vitamins are found in fatty substances which gall bladder patients usually can not tolerate. Butter is recommended as the safest fat as a source of these vitamins.—JANE STAFFORD.

ITEMS

A STAR that is either the nearest or the second nearest star to the earth has been discovered at the Yerkes Observatory of the University of Chicago. It is named Wolf 424 and it has a visual magnitude of 12, which means that, close as it is, it can be viewed only with a powerful telescope. Professor G. P. Kuiper in recent months has obtained spectra of many faint stars of large proper motion, that is, they change their positions considerably in relation to other stars. He used a fast one-prism spectrograph attached to the 40-inch Yerkes telescope. Star Wolf 424 was found to have what astronomers call a very late M type spectrum which is duplicated in the heavens only by Wolf 359 star. This is the intrinsically faintest star known. The distance of Wolf 359 is eight light years (two and a half parsecs), that is, it takes light traveling 365,000 miles per second only eight years to travel from that star to the earth. But the Wolf 424 star newly observed is found to be 1.17 magnitudes brighter. Computations show that its probable distance would therefore be about 3.7 light years.

REPRESSURING, a new method of increasing oil production from partially depleted fields, recently applied near Lexington, Ky., to oil pools in the "corniferous" formation, has already caused a great increase in production, making available oil that would be forever unavailable to older recovery methods, according to Dr. Newell M. Wilder, who reports the work in the *Bulletin* of the American Association of Petroleum Geologists. Production of many wells was tripled when adjacent wells were filled with air under a pressure of 200–300 pounds, a few wells giving even greater increases. Four pressure wells to one producer, spaced only a few hundred feet apart, gave the best results in this field, although in some other field different spacings and pressures might work better. Telling what was done, and how it worked in this particular field, Dr. Wilder pointed out that these methods should not be applied indiscriminately in other oil fields, where conditions might be different.

ALL that remains of an early mouse, which dates back to the Paleocene Age 80,000,000 years ago, are a few teeth. Professor Glenn L. Jepsen discovered these in south central Montana in 1931, but only recently learned their significance. He now is certain that they came from a member of the rodent family and has named the animal *Paramys atavus*, meaning mouselike grandfather. Parts of the left wing of a 50,000,000-year-old duck were discovered in northeastern Utah during an expedition under the auspices of Princeton University in 1936. The remains were unearthed from an Upper Eocene deposit by John Clark, now at the University of Colorado. Dr. Alexander Wetmore, of the U. S. National Museum, has built up a probable body structure around them.

A NEW industry is growing up at Greer, W. Va., around "silica black," a new carbon and silicon-bearing material derivative discovered six years ago by Professor C. A. Jacobson, of West Virginia University. Produced when coal and a material like diatomaceous earth are mixed and distilled at 600 degrees Fahrenheit, "silica black" is an inky-dark powder for which a wide variety of uses is being found.

SCIENCE NEWS

Science Service, Washington, D. C.

THE NEUTRINO

NEW experimental research, strongly indicating the existence of the long-sought atomic particle, the neutrino, is announced by Drs. H. R. Crane and J. Halpern, at the University of Michigan. Reporting in the *Physical Review*, they described new methods of studying impact relations in atomic collisions.

"This is the first experiment," according to the authors, "which has given any information at all regarding the momentum relations in the individual disintegration event. Although the results are of limited accuracy they strongly indicate that momentum is not conserved between the electron and the nucleus alone. Hence the laws of momentum, as well as those of energy, indicate that a third particle participates in the disintegration. This third particle, while undetected of itself, is probably the long-sought neutrino."

A gaseous compound of radioactive salt was placed in a Wilson cloud chamber, a device which renders visible the tracks of ionizing particles liberated in radioactive disintegrations. Several times previously the disintegration of a substance in the form of a gas has been suggested as a key experiment for measuring the momentum or energy of recoil in atomic studies. The difficulty has been that the length of track made by the recoiling nucleus is far too short for observation, even in a cloud chamber operated at the lowest obtainable pressures.

Drs. Crane and Halpern, however, circumvented this experimental difficulty by allowing the ions formed to diffuse, for a little while, until the clusters created attained a diameter of several millimeters. The individual droplets in these clusters could then be counted and the energies of the motion of the recoiling nucleus could be estimated. By applying magnetic fields and bending the tracks of the particles the momentum of the nucleus could be compared with that of the electron.

The result of the research shows that the basic laws of the conservation of energy and of momentum (fundamental building stones of physical theory) do not appear to be obeyed for the collisions created. Rather than abandon these basic laws, which are so well substantiated everywhere else through the field of physics, Drs. Crane and Halpern believe a third particle, the neutrino, took part in the collision so that it was a three-body, instead of a two-body, impact. Such a condition could easily explain the experimental results obtained.

THE MOTIONS OF DOUBLE STARS

DR. LEOPOLD INFELD, of the Institute for Advanced Study at Princeton, has cleared up an astronomical puzzle on the motions of double stars. Dr. Infeld's study, entitled "Electromagnetic and Gravitational Radiation," appears in the current issue of the *Physical Review*.

Gravitational radiation may be a new term and concept to many laymen and scientific men alike, but astronomers have been wondering for some time if the effects of energy dissipation through gravity might cause a shift in the orbits of double stars. Theoretically it was suggested that, perhaps, double stars might gradually come closer together due to gravitational radiation. In Einstein's theory of relativity the equations expressing the gravitational field have the form of a wave equation. Disturbances in the gravitational field energy are pictured as being propagated by waves through space. Such disturbances have come to be known as gravitational radiation. Dr. Infeld, who collaborated with Professor Einstein recently in writing the book entitled "Evolution of Physics," has shown mathematically that for the cases of double stars the energy losses in the system, due to gravitational radiation, turn out to be negligible. He points out that the result shows the astonishingly small rôle played by the gravitational radiation in the motion of double stars.

PETROLEUM PRODUCTION

THE chemical process of cracking heavy crude oil, to get greater yields of gasoline, saved the world 2,000,000,000 barrels of crude petroleum in 1937, according to a report made by Dr. Gustav Egloff, of the Universal Oil Products Company, Chicago, to the joint meeting of the International Congress of Chemistry and the International Union of Chemistry held recently in Rome.

World production of crude petroleum was about two billion barrels last year, but it would have required 4,000,000,000 barrels of oil to produce the world's needs of gasoline, if cracking processes had not been available. Thus, at an investment of $600,000,000 in cracking plants, modern chemistry saved an amount of crude petroleum equal to the entire world production. By the cracking process, too, a vast store of by-products resulted which are capable of blending with ordinary gasoline to produce the high-efficiency 100 octane fuels for aviation. Typical are the ethers so obtained. One of them alone, known as isopropyl ether, is now available in amounts of 420,000,000 gallons a year. By blending isopropyl ether with 40 per cent. of 75 octane gasoline, and adding 3 cubic centimeters of tetraethyl lead per gallon of blend, there results a superior 100 octane aviation fuel. A billion gallons of such fuel can now be produced yearly. Potentially some 2,500,000,000 gallons of 100 octane aviation fuel can be obtained from the various ethers available through the cracking of crude petroleum.

From crude petroleum, too, is obtained valuable isooctane, which is another useful blending agent to produce the high-powered, anti-knock aviation gasolines. When all plants now under construction are producing, Dr. Egloff estimated that 3,700,000 barrels of isooctane can be made yearly. By blending this with 60 per cent. of 74 octane gasoline there would result nearly 10,000,000 barrels of 95 to 100 octane aviation fuel. In commercial aviation these super gasolines are used at take-off, when great power is needed. When they become avail-

able in quantities, and at a price, for regular use, the pay-loads of airplanes will increase markedly. Dr. Egloff estimates that if the engines of the China Clippers and other trans-oceanic flying boats were now equipped to use such fuels there would result a saving of $2,000 for each flight across the pacific.

PLATINUM IN THE LA PLATA MOUNTAINS

THE discovery of "promising" amounts of platinum in the La Plata Mountains of southwestern Colorado on unclaimed public land open for location is announced by the U. S. Geological Survey. It is the first promising platinum find in continental United States. Found by a chemical analysis of ores collected by Edwin B. Eckel, who has been doing field work in the La Plata region for several years, the platinum metals content of some samples is as high as .54 ounces of platinum and palladium per ton. Platinum currently sells at $33 an ounce. Experts of the Geological Survey declined to advise on possible production and methods of working this deposit. From other sources it was learned, however, that if the ore body found is large enough, the platinum can best be mined on a by-product basis—the ore body worked for copper and the platinum metals recovered during the electrolytic refining processes. This method of recovery has already proved successful in Canada.

A possible rush of prospectors to the district, not far from the silver mines of Durango, is foreseen. According to the Geological Survey, the new finds warrant at least "thorough examination." Occurring two miles above sea-level on Copper Hill, between Bedrock and Boren Creeks, near the old town of La Plata and 21 miles northwest of Durango, the platinum-bearing veins have already produced 4,500 ounces of silver and 225,000 pounds of copper. Most of this production occurred between 1911 and 1917, when a great "glory hole" and a 600-foot tunnel were excavated. Buried by soil and the débris from an ancient glacier, much of the ore body is hidden, and only a fraction of it, known to be 150 feet in diameter and 50 feet deep, is exposed. Further exploration by diamond drilling will show the extent of the platinum-bearing rock.

A NEW TYPE OF LANTERN SLIDE

A NEW type of lantern slide has been perfected and put in use at Princeton University.

Consisting of a small-sized 35 mm microfilm held between two ordinary microscope slides, the new lantern slide costs less than a cent and a half to make and is considerably easier to transport and pack than the present type. Single frame movie 35 mm film may also be used. Dr. Hubert N. Alyea, assistant professor of chemistry at Princeton, who devised the slide for his illustrated introductory chemistry course, said "our art department alone would save more than $20,000, if they had put 25,000 of these slides on file instead of the regulation big size." Dr. Alyea has also invented a new mechanism whereby the speaker can by remote control change slides and lights in the projector in the back of the room. This has not yet been applied to the small-sized projecting unit.

The lantern slides now in use measure 3¼ inches by 4 inches and require an expensive process to expose and develop the special emulsion on their face. Thus the price of a finished slide ranges from seventy-five cents to three dollars, according to whether black-and-white, or colored pictures are desired.

Dr. Alyea's diminutive slides measure 1 by 3 inches, and their developing is that of a simple camera film. The biology microscope slides may be procured at two for a cent, and the finished black-and-white film costs less than half a cent a frame, a saving of more than 73 cents per slide. Finished Kodachrome frames cost less than 14 cents, a saving of more than $2.85 per colored slide. Considerable economy can also be effected in the camera and projecting equipment.

"When unversities wake up to the possibilities of these miniature lantern slides, they will be universally adopted, and the old-fashioned plates will be relegated to the past along with the horse and buggy. A national clearing-house for chemical slides could keep thousands of strips of negatives on hand. For five cents apiece (which would include the cost of mailing) it could print positives, clip them off, put them in slides and still make a profit."

Other advantages of Dr. Alyea's slides are that they may be stored in a regular biology micro-slide file, which holds eight times as many as the usual slide file and takes up about one sixth the space, and that a traveling lecturer can put three hours' supply of slides in his pocket and carry the projector in his hand.

Microfilm reproductions are now furnished by some of the nation's leading libraries. From Bibliofilm Service in Washington copies suitable for use in Dr. Alyea's slides may be procured for about a cent a picture. Five-and-ten-cent stores retail yard-strips of educational movie (35 mm) film for ten cents. Thus illimitable educational resources are open to the public for a song.

Depreciation is slight, since the label is glued between the slides and can not be lost, there is no tape around the edges to fray, and if the slide is dropped and broken one need merely pick out the film (which was not in contact with the glue itself) and put it between another pair of slides—cost one cent.

HOMEOSTATIC MECHANISMS

THE reason why it takes a young man to win the 100-yard dash and an older man to win a marathon or set a record for the 10-mile race is the same as the reason why old people seek a place by the fire and wear heavier clothing than young people. The explanation for this was given in a lecture by Professor Walter B. Cannon, of the Harvard Medical School, at the Mount Sinai Hospital in New York City.

Nurmi set the 10-mile record when he was 31 years old and old men and women hug the stove because of the aging of "homeostatic mechanisms." This term refers to the mechanisms which keep the blood and other body fluids stable and which also, as shown by recent research, maintain uniformity over other conditions in the body. As examples of some of these other conditions, Dr. Cannon gave the flushing of active muscles with abundant blood when they are vigorously at work, thus providing them

with oxygen and washing away their waste; the special provisions for an adequate blood supply to essential and highly sensitive organs such as the brain and heart when severe hemorrhage occurs, the blood supply to other parts of the body being temporarily diminished at such times in order that there may be an adequate flow to these structures which are of supreme importance to the organism; and the plenteous blood supply to glands of internal secretion such as the thyroid and adrenal, which put forth locally from their surfaces powerful secretions.

Describing what happens when the mechanisms for maintaining these conditions begin to age with the rest of the body, Dr. Cannon said: "As men grow older the body temperature is maintained at the usual fairly uniform level, but the agents maintaining it become gradually more and more defective. The rate of heat production in the body gradually falls until it is about 25 per cent. less in late senescence than it is in early manhood. For this reason old people seek a place by the stove or open fire or other source of heat, or wear heavier clothing than the young.

"There is also a gradual lessening of the ability to accommodate to high temperature because sweating and dilation of the surface vessels, by means of which heat is lost from the body, become deficient as the skin undergoes atrophy and the blood vessels stiffen in later years of life. For this reason there is a sharp rise in the death rate from heat strokes in the decades after the seventieth year.

"Limitations of similar character are seen when vigorous muscular activity is undertaken. The bounds are set in part by restriction of the so-called 'vital capacity'—the maximal to-and-fro movement of the air in breathing. From early manhood until the sixtieth year the reduction may be 20 per cent. and by the ninth decade it may be reduced more than one third. This is largely due to increased stiffening of the chest wall.

"Furthermore, the blood pressure is likely to raise in the late years because the arteries become less elastic and therefore do not adapt themselves to the needs of the active muscles in physical exertion.

"The heart likewise shows a lessened ability to adjust itself to bodily needs; in experimental tests the maximal heart rate in youth during maximal work averaged 196 beats per minute, whereas in the 60's the maximal rate was 163 beats per minute, a reduction of about 16 per cent. As a result of these limitations insufficient oxygen is delivered to the active muscles to burn the lactic acid which is produced by vigorous muscular exercise, and consequently performance is much reduced.

"In harmony with these observations there is the fact that records in competitive sports are held by young persons when quick actions are required, and by older persons when slower actions are allowed. The record in the 100-yard dash was made by a young man of 21 years. The running records from 1 to 5 miles are held by men from 23 to 27 years of age. The record for 10 miles was made by Nurmi when 31 years old. DeMar, who ran marathons between his twenty-second and his fiftieth years, was at his best between 36 and 42. Baseball players are rarely first-rate after about the middle of the fourth decade. Indeed, there are few stars in sports after forty. These limitations are due to the gradually reduced ability of homeostatic mechanisms to maintain stable states in the body fluids as one grows older."

ITEMS

ROBOT recorders of the slow and complicated motion of glaciers, recently used at Spitzbergen by Dr. Hanns Tollner, of the Vienna Meteorologic Observatory, their inventor, have disclosed a new ice motion. Long ago, the forward creep of glacial ice was known. Now, Dr. Tollner's instruments show an intermittent motion, likened to jolting, in addition to the forward creep. Jumping forward at times, the ice may move as much as four inches in a few minutes, in addition to its steady motion. Sideward ice motions, and vertical movements, up at the edges of the ice and downward at the center, were also indicated by the Tollner instruments. Changes in air temperature, according to Dr. Tollner's observations, may cause shifting of the position of the ice front of as much as 20 per cent. of the ice length. From observations in the Alps, he found that high air temperatures cause rapid ice motion, while lower temperatures reduce the speed.

WATER is an important component of molten rocks, even though at high temperatures it is a gas, according to a report of Dr. George W. Morey, geophysicist of the Carnegie Institution of Washington, who described his researches into rock chemistry before the New York Section of the American Chemical Society. "Liquids dissolve gases, but when dissolved the gas is no longer a gas but one component of the liquid." He likens the dissolved water (a gas at rock temperatures deep in the earth) to the carbon dioxide dissolved in the water in a bottle of soda-pop. Until the pressure is released, the dissolved gas is a part of the liquid. Deep in the earth, molten rocks, during the various cooling processes which lead to the formation of ore bodies, drop out one component after another, causing the proportion of water in the melt to increase, and to become more important in the later stages of the cooling process. During those closing stages of volcanic activity, when water is chemically very important, hot springs are the means of escape of the excess heated water.

EVEN from Stone Age days, Sweden's inhabitants have been Nordics, according to Dr. Hanna Rydh, archeologist of the University of Upsala, now lecturing in this country. The oldest human skull found in Sweden dates from somewhere between 6000 and 8000 B. C., and is of the long and narrow shape characteristic of the Nordic. A few broad-headed people of the physical type characteristic of central European countries did migrate into Stone Age Sweden, but the land remained predominantly Nordic in population. Dr. Rydh, who recently excavated the tomb of a Swedish king of the Viking age, states that the Vikings made their famous long-distance voyages, not so often for belligerent raids, as for the prosaic business of trading for a living. They were driven to become international traders because the oldest son of a household inherited the farm, and the younger sons had to find careers for themselves.

SCIENCE NEWS

Science Service, Washington, D. C.

THE USE OF SOLAR ENERGY

METHODS of creating "sun power" by converting solar energy into a form in which man can use it as a source of power will be the goal of a comprehensive program of chemical, electrical and mechanical research to be undertaken in the near future at the Massachusetts Institute of Technology.

Enabled by a $647,700 gift from Dr. Godfrey L. Cabot, of Boston, the research will be devoted specifically to a search for direct means of converting the sun's radiant energy into useful power or storing such energy for future use. Under the terms of the gift the income from the fund must be used in these studies for at least fifty years, after which it may be diverted to other purposes at the discretion of the corporation of the institute.

At the institute investigators will concentrate on direct physical and chemical methods of using solar energy. Research workers at Harvard University, which received a similar grant from Dr. Cabot last year, are making a pioneering study of the possibilities of speeding up the growth of trees, and thus "streamlining" the conversion of sunlight into forms suitable for human use.

In announcing the gift, Dr. Karl T. Compton, president of the institute, commented on the enormous potential power of solar energy, pointing out that heat from the sun reaches the earth in the temperate zones at an average rate of approximately four million calories per square yard daily. In the three months of greatest sunshine an acre of land, he estimated, receives directly from the sun an amount of heat equivalent to that which would be produced by the burning of about 250 tons of first-class coal. "The store of energy in our familiar fuels, while great, is not inexhaustible," he continued, in pointing out the importance of such research.

A primary object of the project will be to determine whether use of solar energy is economically feasible and practical. Solar energy devices already proposed and studied elsewhere will be evaluated with this point of view in mind. The second aspect will consider chiefly the feasibility of developing new conversion equipment using phenomena now under study which hold promise of ultimately being useful in the solution of this problem.

LIGNIN AS A SOURCE OF CHEMICAL RAW MATERIALS

CHEMISTRY is at last learning a way to convert lignin, great waste product of the nation's forests, into highly valuable raw materials. In a report issued jointly by the U. S. Forest Products Laboratory and the University of Wisconsin, a laboratory method is described of converting lignin into useful materials. They include: a well-known organic solvent, wood alcohol; a new compound, propylcyclohexanol, which appears suitable as a lacquer solvent and which has also possibilities as a wood preservative; two compounds having possible use as thickening and toughening agents for varnish; and a clear, glassy resin, extremely adhesive, which has excellent potentialities as a plastic material.

The process of hydrogenation, already used to make petroleum oils out of coal and cooking fats out of vegetable oils, is the one employed in turning lignin, once a waste, into a valuable forest resource. Atoms of hydrogen are added to the ligning in solution by means of heat and pressure. By this severe treatment the dissolved ligning is changed from a dark-brown color to transparency. The different compounds created are removed by distillation.

The work, still in the experimental stage, is the latest development in the long course of research, seeking valuable uses for lignin, which has been carried on by Drs. E. C. Sherrard and E. E. Harris, of the Forest Products Laboratory. The present hydrogenation experiments were performed in cooperation with Dr. Homer Adkins, of the University of Wisconsin, who discovered the effectiveness of the copper-chromium oxide, used as a catalyst in the tests.

Lignin comprises from 20 to 30 per cent. of the stems of trees and other woody plants. In the current research it is estimated that more than 70 per cent. of this lignin can be converted into chemical raw materials having industrial possibilities. The yield of wood alcohol obtained is several times as great, by the new process, as it is from the usual distillation of wood alone. One ready source of large supplies of lignin is the 1,500,000 tons of the material annually discarded by factories making pulp for rayon and for the better grades of white paper. Research is now in progress to free these waste liquors of their sulphur content. If this can be done on a commercial scale, such plant wastes will turn into valuable raw materials for chemistry.

DISADVANTAGES IN THE USE OF ACID TO INCREASE OIL WELL PRODUCTION

THE use of acids to increase production from oil wells has brought in its wake a major trouble for the petroleum industry in the form of thousands of miles of ruined pipelines and hundreds of ruined refinery units, according to reports by petroleum engineers. Fifty million pounds of salts, produced largely as by-products of the acid "dosing" of wells, are eating the walls of expensive pressure piping and plugging refinery tubes, exacting a stupendous economic toll They are in addition lowering the value of residual oils and tars, eating up in waste a considerable portion of the increased income earned by use of the acid process which increases the wells' yield. Greater even than the cost of replacement parts and labor is the loss caused by equipment being out of service while repairs are made.

Petroleum engineers are turning increasing attention, however, to this problem and report a number of desalting methods. Heat, pressure and the addition of fresh water remove some of the salt from commercial crude oil, greatly increasing the life of piping and refinery equipment at a low cost. A Michigan installation, described in *Petroleum Technology* by Dr. Gustav Egloff and a group of petroleum engineers of the Universal Oil Products Com-

pany, reduced the salt in incoming crudes from 220 to 5 pounds per thousand barrels. Incoming oil was mixed with about 10 per cent. of water, then heated to 250 degrees under a pressure of 60 pounds. The salt removal, 212 pounds for each 1,000 barrels of oil handled, reduced corrosion from a continual cause of breakdowns to a very minor maintenance factor. Chemicals to break up the shell of emulsion which protects brine globules from the surrounding oil have been used with some success. Once this protective coating is destroyed, water particles settle out of the mixture very rapidly, carrying the salt with them. Different chemicals are needed in each oil-producing area, and the search for a general desalting chemical agent, suited to all types and mixtures of oil coming to a refinery, is still going on.

Electrical desalting, in one plant, decreased the salt content of the crude oil from 200 to 8 pounds per 1,000 barrels. This particularly corrosive crude oil, from an Arkansas field, was mixed with water, then subjected to an alternating potential of 16,000 to 32,000 volts. Before the desalting equipment, still tubes were completely blocked with deposits of solid salt after turns of only three to six days, and corroded excessively. After desalting, runs of 60 to 70 days without shutdowns were the regular thing, with less corrosion per run. Whirling an oil-salty water mixture to remove the salt water offers considerable future promise, the engineers report. In test runs, centrifuges have removed all but a half pound of salt from oil originally containing 160 pounds per 1,000 barrels.

A NEW PULVERIZER

FINER face powder, made at less cost, is one immediate application of a new super-pulverizing device which has been introduced to the chemical engineering profession. The new pulverizer will grind particles to a size finer than the finest sieves. Particles can be obtained, economically and on a commercial scale, which correspond to 2,500 theoretical mesh, or only 5 microns in size. A micron equals a thousandth of a millimeter, or about four one-hundred-thousandths of an inch. The new machine blows particles of a material together until they attain minute size by mutual fracture. Besides finer face powder, the device makes better mineral fillers for writing paper, finer insect and fungicide powder, paint and rubber pigments and the powders which are turned into the useful and beautiful plastic products.

A sealed pancake-shaped container is the grinding unit. One eighth inch diameter particles enter this unit for pulverizing. Multiple jets, around the peripheral wall of the chamber, shoot in streams of compressed air, or superheated steam, at pressures of from 100 to 500 pounds to the square inch. The direction of the jets creates a rapid whirling motion of the material within and a small amount of material, placed in the air jet stream, does the grinding, by impact, as it strikes the inner mass. Because of the whirling motion centrifugal forces are set up in the chamber which move the larger particles out to the peripheral region and into the severe blasts of air. As the particles become smaller they gradually work toward the center and fall, downward and off, into a collecting receptacle. Surprisingly enough, the tremendous pulverizing action is obtained almost without action by the confining walls of the chamber. The grinding is between particles themselves. The new device, known as a "Micronizer," was developed from the invention of Norwood H. Andrews by the International Pulverizer Corporation of Camden, N. J. It is not sold, but is used under license. The first technical description of its design and operation, outside of the original patent specifications, appears in the current issue of *Chemical and Metallurgical Engineering*.

A NEW TYPE OF AIRPLANE ENGINE

FINAL acceptance tests for a U. S. Bureau of Air Commerce rating have been completed at the Massachusetts Institute of Technology for a radically new type of airplane engine declared by its designers to be smaller and lighter than comparable engines of conventional type. Developed by Heraclio Alfaro in cooperation with engineers of the Engine Laboratory of the Massachusetts Institute of Technology and of the Indian Motorcycle Company, the new engine is of the so-called "barrel" type. It is believed to be the first engine of this design able to meet performance requirements of the Air Commerce Bureau.

With its cylinders parallel to the crankshaft on which the propeller turns, instead of perpendicular to it as in radial and V-type engines, the "barrel" engine is one of the most compact ever designed. Its diameter, exclusive of small protruding parts which may possibly be eliminated in later models, is but 15½ inches. More powerful models will still be much narrower than to-day's great radial engines, with consequent decrease of wind resistance in aviation use. The model built by Mr. Alfaro with the help of Professors C. F. and E. S. Taylor is a four-cylinder crankless engine. It developed 115 horsepower at a speed of 2,000 revolutions per minute. Built of cast iron and without any special effort at constructing a light-weight assembly, the engine weighs 240 pounds. Larger models with more cylinders grouped closer together and manufactured from lighter materials will produce a liquid-cooled engine weighing slightly more than one and a quarter pounds per horsepower. A unit which he believes will develop up to 2,000 horsepower and weigh less than 2,000 pounds is projected. "Wobble-plates," curving fins attached to the crankshaft, are pushed by rods on the piston rods to transmit the power developed in the cylinders. Compactness of the compression chamber and absence of hot valves allow a much higher compression ratio, making for great fuel economy. Further development of this type of engine, which is considered to hold promise of successful application, is expected.

A NEW WHOOPING COUGH VACCINE

BETWEEN 800 and 1,000 children somewhere in the United States, all born since July, 1935, are going to show scientists within the next two years whether or not a new whooping cough vaccine prepared at the U. S. Public Health Service's National Institute of Health gives better protection against this serious childhood

plague than the vaccine now in use. Dr. W. T. Harrison, Senior Surgeon, U. S. Public Health Service, who is in charge of this new disease-fighting venture, has just returned to Washington from an unnamed city where he superintended the vaccination of from 400 to 500 of the children. He said that the name of the city must be kept secret or the test will be spoiled because mothers of unvaccinated children will insist on having their children vaccinated.

Since there is no test for immunity to whooping cough like the Schick test for diphtheria, the only way to learn the effectiveness of the new vaccine is to watch two large groups of similar children, one vaccinated and one unvaccinated, and see how many in each group gets whooping cough or fails to get it in the natural course of events. This will require about two years' time. Very encouraging results were obtained with the new whooping cough vaccine in its first trial in Cumberland, Md. Reporting these results in the current issue of the Public Health *Reports,* Dr. Harrison and associates, Dr. Joseph A. Bell, of U. S. Public Health Service, and Dr. Joseph P. Franklin, Deputy State Health Officer, Maryland, were extremely conservative because of the small number of children in the group. Among 82 vaccinated children, 10 cases of whooping cough developed during the year, while among 109 unvaccinated there were 21 cases of whooping cough. This is considered too small a difference to give conclusive evidence of the vaccine's value and that it why the larger trial has been started.

The new vaccine is prepared by precipitating the Sauer whooping cough vaccine now used with alum, a process something like that used to prepare diphtheria toxoid for diphtheria immunization. The alum precipitation treatment makes it take much longer for the vaccine to be absorbed by the body. This gives a chance for more whooping cough antibodies to be formed in the body and should therefore give greater protection against the disease. Another advantage is that only two doses of the new vaccine are used, whereas with the old type six doses must be given.—JANE STAFFORD.

ITEMS

WOLF 424 has been demoted from its recently proclaimed position as the nearest fixed star in the heavens. A short time ago Dr. G. P. Kuiper, of the Yerkes Observatory of the University of Chicago, found from the star's spectrum that it had the very large parallax of eight or nine tenths of a second, which meant that it was relatively close to the earth. Now Dr. D. Reuyl, of the Leander McCormick Observatory of the University of Virginia, using photographs of 1925 and 1926, has found by the trigonometric method a preliminary parallax of only one quarter that determined at Yerkes. This means that instead of Wolf 424 being the nearest star, there are more than 30 stars which are our nearer neighbors in space. A year from now a better parallax will be obtainable through continued observations at the McCormick Observatory.

ACCORDING to a report by Ralph Keeler, mining engineer, sooty black rocks from many places in the Philippine Islands may become a new source of wealth as this rock is found to contain manganese, important steel-hardening agent. With the initial production of 255 tons in 1936, output increased to 12,206 tons in 1937, and production is increasing daily as more deposits are located and developed. Occurring in lens-shaped deposits of hard black psilomelane, a mineral that assays 50 per cent. metallic manganese, the ore bodies are worked by hand labor. After preliminary purification the ore is shipped to the seacoast, for eventual sale to Japan, the United States and Italy. Japan is the largest buyer of Philippine manganese at present. Mechanized mining is expected greatly to increase the output in the near future.

MOUNT MITCHELL in North Carolina and Mount Washington, popular vacation spot in New Hampshire, retain their titles as the highest mountains in North America east of the Rockies. Reports of a chain of mountains in northern Labrador topping the two-mile-high peaks are finally disproved with the publication by the American Geographical Society of the first detailed map of the region. It shows that the highest peak in this supposedly sovereign range is less than 5,500 feet high. The map accompanies "Northern Labrador Mapped from the Air," the record of three aerial survey expeditions to inaccessible northern Labrador. Aerial survey photographs covering 5,000 square miles of inaccessible territory were made by the three expeditions, under the direction of Dr. Alexander Forbes, professor of physiology at the Harvard Medical School. Old surveying methods would have required much more time and money, it was stated.

A MAGNETIC telephone requiring no battery or other source of outside electric current for its operation has been developed by engineers of the Bell Telephone Laboratories, according to G. E. Atkins, of the staff. Depending on voice vibrations to move an armature placed in the field of a permanent magnet for generating the current which carries speech, the same unit may be used as receiver or transmitter. The instrument recalls early telephone receivers and transmitters which likewise were magnetic and used no outside source of current. They had, however, too low an output to be practical. It is only in recent years that knowledge of highly magnetic materials and structures has enabled practical use of this type of circuit. Independence of batteries or other outside power source makes the instrument portable and suitable for use in places such as construction camps. A special portable unit weighs less than two pounds. A wall unit contains separate receiver and transmitter.

DR. A. H. B. KIRKMAN, of the London University Animal Welfare Society, reports that the African elephant is being killed off at a rate faster than it can reproduce itself. They are being killed off at the rate of 36,500 a year. Between one and two thousand hippotami are being killed annually in their last remaining haunts in Tanganyika and the great Central African lakes. The introduction of modern methods of killing in the last 130 years has had disastrous results. The generation now being born will see the last of the African fauna in the wild state if the mentality of European nations occupying territory in that continent remains unchanged.

SCIENCE NEWS

Science Service, Washington, D. C.

LEAD AND THE EARTH'S HISTORY

RECENT experiments at Harvard University indicate that the metal lead, already used in scientific estimates of the age of the earth, may also yield important clues to the earth's history back farther than ever before into the ages following the earth's birth from the sun. Studies made by Dr. Alfred O. Nier, national research fellow in the Harvard physics laboratories, indicate that atoms of the metal may hold locked within them at least a partial record of chemical and physical developments when the earth was young.

His studies concern the ordinary variety of lead. A second type of lead, derived as the end product of the decomposition of uranium, a radioactive element, has already won wide fame as a measure of the earth's age. Essentially, Dr. Nier's discovery is that the relative proportions of the isotopes of this metal, ordinary lead, vary considerably from sample to sample. Ordinary lead, for example, has four isotopes, weighing 204, 206, 207 and 208 atomic units. According to Dr. Nier's experiments, the relative abundance of these isotopes may vary as much as 15 per cent. It has heretofore been believed that the isotopes of lead had a certain, fixed ratio. This peculiar isotope distribution dates back millions of years and was probably caused, according to Dr. Nier, by the early contamination of ordinary lead in its primitive forms by the lead formed from the radioactive elements, thorium and uranium.

Further study of this variation and its significance may indicate that the ordinary lead atom carries within it a partial record of physical and chemical developments when the earth was young. They also expect to secure important new clues to the mechanism of the formation of lead ores. The key instrument in the research is a special mass spectrometer, believed to be the most delicate "atom sifter" known to science. Not only can the apparatus detect the presence of rare isotopic forms, heretofore a fairly difficult procedure, but it can also yield the most accurate measurements ever made of the abundance of different isotopes present in an element.

Dr. Nier has also studied sixteen other elements as the start of a comprehensive research program which will eventually put every one of the ninety-odd known elements through his spectrometer. His studies are also providing a check on the use of the other type of lead in the "radioactive clock" estimates of the earth's age.

INCOMING COSMIC RAYS

INVESTIGATORS believe that they have an answer to the fact that the piercing, incoming cosmic ray electrons are charged with positive electricity. The annihilation of the cores of atoms, containing only positive charges, and their conversion into cosmic rays is suggested as the cause, in a report of Professors Robert A. Millikan and I. S. Bowen and Dr. H. Victor Neher, of the California Institute of Technology. At the recent meeting of the National Academy of Sciences in Washington, they reported how their high-flying balloon ascensions in India, Texas, Nebraska and in Canada indicated bands of cosmic ray energies which can best be explained by the annihilation of common atoms like oxygen, nitrogen, carbon, aluminum and so on.

In their new report, published in *The Physical Review*, they state: "If there is, in fact, the possibility of the complete transformation of the mass of a nucleus into cosmic radiation, *i.e.*, into oppositely ejected electrons (or less frequently into two oppositely ejected photons), since only positive charges exist inside the nucleus, the hitherto strange fact that the incoming electrons are certainly predominantly positive, quite possibly exclusively so, would perhaps be less surprising than it is at present."

The balloon research, they add, shows that the observed cosmic rays have never previously encountered matter as dense as the vaporous atmosphere of the earth in their age-long journeys through inter-stellar space. This rules out the possibility that cosmic rays originate in the interior of stars.

THE STUDY OF THE IONOSPHERE

AFTER a four-year shut-down, the ionosphere observatory at Harvard University has this spring resumed its radio study of the little-understood blankets of atomic particles which surround the earth like a shell a hundred miles or so up.

Long-distance wireless communications would be impossible without the ionosphere and it is believed that continuous records of changes in it will be a great aid in improving radio communication. A further study of its peculiarities may also yield important information concerning the sun, the nature of the upper atmosphere and the weather. It is important that the records be continuous, for the ion layers unceasingly shift back and forth, sometimes very rapidly, throughout the day and night, chiefly as a result of changes in the intensity of the sun's radiation. The observatory is now making automatic observations twenty-four hours a day, of the heights of the ion layers over Cambridge. The importance of the research is accentuated by the fact that the Harvard laboratory is believed to be the only station in the United States now making these valuable continuous observations of the upper air on a fixed frequency.

Harvard expects to supplement its Cambridge observations within a few weeks with a program for continuous short-wave radio transmission and reception between the Harvard laboratories and a station at Rensselaer Polytechnic Institute at Troy, N. Y. In addition to observations by automatic equipment at the two stations a specially equipped radio truck will make field observations at in-between points.

Related research is being conducted by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, which operates stations in Peru, Australia and Alaska, and by the National Bureau of Standards.

Research workers in this field hope eventually to have at least thirty observatories all over the globe to conduct studies of variations of activity of the layers at different points above the earth's surface.

Observation of the ionized layers, which extend from about 30 to 150 miles above the ground, is possible because the electric character of these blankets is such that they reflect radio waves back to earth. This reflection makes it possible to send radio messages beyond the horizon, that is, around the curve of the earth. The effective heights of the layers can be determined by measuring how long it takes radio waves, traveling with the speed of light, to reach the layers and be echoed back to earth again.

Harvard's ionosphere observatory, directed by Professor Harry R. Mimno, was established in 1932, but had to be discontinued in accordance with the Federal Communications Act of 1934, which prohibited the operation of any radio station without continuous attendance of an operator. The act was amended last spring to permit scientific research by automatic transmission, and after a year's preparation the work has been recently resumed. Two devices which automatically transmit and record signals on fixed wave-lengths of about 80 meters and 150 meters and another automatic transmitter and receiver sending signals of regularly varied wave-lengths are now in use.

ABNORMAL BRAIN WAVE PATTERNS

PEOPLE who have "queer ideas" show it in their brain wave patterns as well as in other more obvious ways. This and many other facts that are being discovered about the characteristic patterns made on paper by electrical hook-up with a person's brain were discussed at the recent meeting of the American Psychiatric Association in San Francisco.

The queer or abnormal brain wave patterns found in persons who have "queer ideas," and in others who have phobias, or who show signs of psychosis or other mental disturbances, were described by Dr. Frederic A. Gibbs, and William G. Lennox and Mrs. Erna L. Gibbs, of Boston.

The brain wave patterns consist of rhythmic wavy or spiked lines traced on paper. They constitute a record of the electrical impulses that accompany brain cell activity. These patterns are so characteristic that the Boston scientists consider them as individualistic as a person's handwriting. On this point they stated: "That we are dealing with a fundamental constitutional mechanism which reflects the essential working of the individual brain is suggested by the following facts. Each individual has his own pattern of electrical activity which, like his handwriting, can be distinguished from that of other individuals and which under standard conditions maintain its individuality from day to day. Furthermore, normal persons who are related have records which bear a resemblance to one another, and the records of normal identical twins are closely similar."

Brain wave patterns will, it is hoped, help solve some problems of mental disease, just as similar patterns of electrical impulses from the heart, called electrocardiograms, are helping doctors to learn more about heart diseases. At the meeting Dr. and Mrs. Gibbs and Dr. Lennox reported that brain wave patterns in the widespread mental ailment, schizophrenia, are similar to those in patients with epilepsy. This is considered significant in view of the current theory that epilepsy and schizophrenia are antagonistic conditions. The three main types of epilepsy, grand mal, petit mal and psychomotor epilepsy, are each accompanied by a distinct pattern of brain waves having abnormal rhythm. The brain wave record of patients having psychomotor epilepsy is similar to that of patients suffering from schizopherenia and closely similar to those seen in the majority of children with psychopathic personalities, schizophrenia and certain abnormal behavior like epilepsy.—JANE STAFFORD.

CAROTENE-IN-OIL TO EASE EYESTRAIN

EYESTRAIN and fatigue, common complaints among those doing work that requires close attention, have been relieved among color matchers of the Westinghouse Electric and Manufacturing Company by daily doses of carotene-in-oil, a source from which the body manufactures vitamin A, Drs. Ralph C. Wise and O. H. Shettler report in a recent issue of the *Ohio Medical Journal.*

Three capsules of carotene-in-oil daily, they declare, by speeding up the regeneration of visual purple, light-sensitive substance in the eye, have improved the efficiency of color-matching inspectors by 75 per cent. Color inspectors of the company had long complained of severe headaches, burning and smarting eyes. Many of them declared they were unable to read in the evening after work or stated that they actually feared night driving. These conditions have now been changed by use of the new treatment, Dr. Wise, an eye specialist, and Dr. Schettler, of the company's medical department, assert.

The basis for giving the carotene-in-oil is the fact that visual purple, the light-sensitive substance in the retina of the eye, is decomposed in the process of seeing and can be regenerated only in the presence of vitamin A. Dosing with carotene in effect increases the body's supply of the vitamin so essential to proper seeing. Lack of vitamin A is known to be a cause of night blindness, an eye defect held responsible for a large share of the mounting toll of night automobile accidents.

The possibility of applying this same treatment to other industrial workers required to do eye-fatiguing work is held out by the Ohio doctors. An interesting by-product of the tests, which Dr. Wise expects to repeat elsewhere, was an appreciable improvement in the health of the workers treated, particularly in cases where fatigue headaches and eyestrain were chronic. Several workers reported gains in weight.

The eyestrain is produced not only by the close application of the eyes required, but also by the unusually bright light in which the work must be done. This light has a tendency to destroy visual purple and reduce the "light threshold." Measurements conducted with special equipment showed, they state, that the rate of regeneration of visual purple was increased. The new

system is said to be saving the company several thousand dollars a year as well as saving employees' vision.

PREVENTION OF WOOD TICK BITES

THIS year's crop of wood ticks is unusually large, particularly in the East. Vacation haunts have hordes of them. More surprising is the fact that vacant lots in cities are for the first time playing host to the common dog, or wood tick. One in several hundred of these ticks may carry the virus of Rocky Mountain spotted fever. That one tick, which in no way can be distinguished from the rest, may cause a fatal infection in the person it bites.

The forthcoming issue of the *Journal* of the American Medical Association carries a statement on prevention of dangerous wood tick bites. Keep the ticks from gorging on the blood of dogs. Pick the ticks off with a pair of forceps or tweezers. Dust the dog every five days with derris powder. Handle the ticks with care. Wear boots laced over the trouser legs when walking in thick-infested regions. Feel the back of your neck and head, their favorite feeding places. Examine children carefully in these spots twice a day. They will reveal the presence of a tick in time to prevent a fatal bite.

Examination of the whole body is necessary after exposure to ticks. If one is found, pull it off at once. Disinfect the bite and the surrounding tissues by inserting a round toothpick dipped in iodine into the exact spot where the tick was attached and drilling it in slightly. To detick clothing, place it in a vessel that can be tightly covered and set on top of it a pan containing half a teacupful of carbon tetrachloride or carbon disulfide. A few hours of such fumigation kills all ticks. Wood ticks are numerous along the eastern coast from Massachusetts to Florida, especially within a few miles from shore. Texas and Florida have a great many. Parts of Iowa, Minnesota and Wisconsin are infested. Islands off the coast of Massachusetts and South Carolina are heavily infested, especially Martha's Vineyard, Nantucket and Naushon. The Narragansett Bay islands have many. The eastern half of Long Island and along Chesapeake Bay in Maryland are other areas popular with ticks.

ITEMS

ORGANISMS that cause a deadly disease to tent caterpillars are being cultured at the New York State College of Forestry, Syracuse, to be released in an effort to control the forest tent caterpillar, which has developed into a major pest this season. The disease has been known for a long time, but this is the first attempt that has been made to propagate it artificially and use it as a means of forest defense. The orchard tent caterpillar, close relative of the forest tent caterpillar, was very bad in 1937, but seems to be on the decrease just now.

THE Japanese medaka, a small yellow fish, has been enlisted by Brisbane, Australia, in its fight against the mosquito pest. Experiments conducted by W. J. Fehlberg, deputy chief health inspector, have proved them voracious devourers of mosquito larvae. They continue to kill even after their hunger is satisfied. Another point in the medaka technique is that they hunt in packs, so that what one misses another usually gets. Their eyes are focussed all the time, and they delight in killing about an inch from the surface. They are too quick to fall victim to other fish, and are not subject to changes in temperature. Most of the imported mosquito-killers will be liberated in ornamental pools and garden ponds where spraying would kill lilies and other plants. Some will go to waterholes used by farmers for watering their stock and where spraying with oil harms the animals.

BIRDS of Siam have three kinds of mass migration, instead of the one kind that is known to temperate zones. Besides the usual north-and-south seasonal movement in which many Siamese species take part, there are also a water migration and a food migration, reports H. G. Deignan, of the Smithsonian Institution. The water migration consists in the movement of vast numbers of water birds toward higher land areas with the coming of the rainy season and its attendant higher water levels in swamps and shallow lakes. The food migration may be simply the result of scouting activities, in which certain individual birds discover places where mangoes, wild figs, and other fruits are ripe, and are then followed by the millions of members of the main flocks. Food migrations are indulged in only by birds of the pigeon and parrot families. Mr. Deignan, after two years of ornithological exploration in remote parts of Siam, is now at the U. S. National Museum, arranging and identifying more than 3,000 bird specimens which he brought back with him.

COOPERATIVE efforts to untangle a botanical Tower of Babel confusion of names are being made by the U. S. National Herbarium, working with the New York Botanical Garden and Harvard University. The confusion has resulted from the publication of more than 21,000 articles and books on the plants of eastern Asia in many languages. The region is a favorite of botanists because of its tremendous wealth of vegetation, but until now everybody who studied the flora has written about it as he pleased and published where he pleased. Resulting confusion has bogged down research in the plant sciences very seriously. Leaders in the effort to get order out of the present nomenclatural chaos are Dr. E. D. Merrill, of Harvard University, and E. H. Walker, of the National Herbarium. Results of their joint efforts are being published as a bibliography of the flora of eastern Asia.

DR. HELLMUTH RIEGG, Germany, reports that a new preparation, derived by chemists from the spinal fluid of animals, is reported to be effective in stanching minor hemorrhages. "Manetol," injected intramuscularly after first being dissolved in water, stops bleeding of wounds in which the tissue is so injured that blood oozes in a number of places and is difficult to stop by any other means. It is intended for use in hemorrhage cases not serious enough to require surgical treatment, but which are nonetheless troublesome. It is said to be effective in hemorrhages from the lungs, stomach, intestines and kidney, and may be used prophylactically in tonsil operations and in the extraction of teeth.

SCIENCE NEWS

Science Service, Washington, D. C.

THE SAN FRANCISCO MEETING OF THE AMERICAN MEDICAL ASSOCIATION

A NATIONAL conference of all medical patent holders to be held at the headquarters of the American Medical Association was suggested by the board of trustees at the recent meeting of the association in San Francisco, as a means of settling the controversial problem of what to do about patents on medical discoveries, such as that of insulin. At present such patents are held and administered by universities, special committees and foundations and by individual physicians. While physicians are prevented by the association's principles of ethics from deriving any income from medical discoveries, technicians or lay persons connected with the same discoveries, it was pointed out, may profit directly. It also appears to the medical association's board of trustees that patents held under present conditions may be used to influence medical research.

THE present wide-spread practice of renting radium by physicians who do not own and are not experienced in the use of this powerful substance was frowned on by the judicial council of the association. It is considered dangerous for a physician inexperienced in the use of radium to use it merely on the advice of another physician who owns a supply of radium but who has not seen the patient, or from a commercial firm owning the radium. Such a procedure, the council decided, amounts to the unethical practice of prescribing for a patient whom the prescriber has not examined.

A CASE, in which the mother's mental age was six years although she was a grown woman and had had three children, two of which died, was described by Drs. Lloyd H. Ziegler of Wauwatosa, Wis., and Charles P. Sheldon of Boston. The occasional marriages of 10- and 12-year-old girls are widely publicized and arouse enormous public comment, but marriages such as they described of feebleminded adults are far more numerous and far more hazardous to society. Nearly a fourth of fifty unselected married patients seen in one large public hospital during four months were feebleminded. Comparison of the indigent and self-supporting group showed that in the indigent group more than 94 babies died for every 1,000 born alive, while in the self-supporting group less than half this number, about 40, died out of every 1,000 live births. The interval between births was about a year among the indigents and nearly two years among the self-supporting. A combination of three measures were recommended by Drs. Ziegler and Sheldon to solve this problem of marriage and reproduction among the feebleminded. These measures are sterilization, which although slow would help certain individuals to "defend themselves from responsibilities they are ill-fitted to carry"; segregation with vocational training; and compulsory registration of persons with intelligence quotients of 70 or less. This registration information should be available to clerks and clergymen responsible for marriage licenses and to courts dealing with criminal offenders. "If the costs of relief, dependency, delinquency and disease attributable to the feebleminded could be transferred to the ledger on the side of wise segregation and training, not only would there likely be a definite and immediate pecuniary saving, but there would also be future dividends of humanitarianism and prevention."

MENTAL sickness characterized by "depressions," a serious form of mental ailment far worse than the attack of "the blues" that it sounds like, may be helped, according to Drs. Richard H. Young and G. Alexander Young, of Omaha, by metrazol, the drug which, like insulin, is helping shock other mentally sick patients back to sanity. All but one out of 21 such depressed patients were helped by metrazol injections. These patients only had to stay in the hospital 21 days, much less than usual for mental sickness, and showed improvement after the first or second treatment. The average number of convulsion-inducing metrazol treatments was seven. Not enough time has elapsed to be sure that the improvement in the patients will be permanent. In spite of these favorable results it is believed that metrazol treatment should only be used as an addition to other forms of treatment. Metrazol and insulin were used alone and together for patients suffering from schizophrenia. A tendency toward relapse from the improvement following insulin treatment for schizophrenia, indicates that this now widely used treatment "fails to offer any special outlook for the future." It is emphasized that in spite of the striking results with insulin and metrazol, treatment of mental disease must continue along broad lines in which the patient's mental functioning and his past, present and future life situations are taken into consideration.

A BABY'S brain may be seriously damaged by giving too large doses of pain-relieving drugs to the mother during childbirth, is the conclusion of Dr. Frederic Schreiber of Detroit from analysis of case records of 500 children with degenerative changes in their brains. Nearly three fourths, 72 per cent., of these children had not breathed immediately after birth or had difficulty in breathing within the first few days. Dr. Schreiber believes that this disturbance in breathing, whatever the cause, was the reason for the damage to the child's brain. One of the effects of the pain-relieving drugs given in childbirth, he pointed out, is to depress the breathing apparatus of the mother. This might occur to such a degree as to endanger the unborn child who is still dependent on the mother for oxygen and nourishment. In one group of 100 cases in which a drug or an anesthetic or both had been given to the mother, records showed that 77 babies had difficulty in breathing. The records also showed that the average dose of drugs given to the mother was four times the ordinary quantity recommended and in some cases was ten times the recommended dose. Examination after death shows that deficiency of oxygen causes microscopic changes in the brain, and Dr. Schreiber believes that the difference between a living baby with a brain damaged from this cause and one born dead is probably only a matter of degree.

DISCOVERY of a new body mechanism which helps toward recovery from pneumonia was reported by Dr. Oswald H. Robertson, of the University of Chicago. The new mechanism consists of certain large, germ-eating cells which appear at a certain point in the disease, engulf the red blood cells, the white blood cells which had previously fought the pneumonia germs, and the germs themselves. It is thought that the patient begins to recover as soon as these large cells appear. This mechanism alone is not considered enough to bring about recovery. Dr. Robertson thinks there is some general, still undiscovered process which does part of the work. Part of the recovery mechanism must lie in the pneumonia-germ-killing power of the blood, any other factor being unknown. If both parts of the recovery mechanism are effective, recovery occurs, but if either one fails, death follows. According to Dr. Robertson, resistance to pneumonia by means of a substance in the blood that kills the germs is not enough to prevent the ailment. Experiments with dogs showed that if there is obstruction of the air passages in the lower part of the respiratory tract, where the lung's mechanism for getting rid of foreign material is not extensive, the disease may develop even if the blood has germ-fighting antibodies. Such an obstruction may occur in a cold when the infection reaches the lower part of the breathing system.

DR. LOUIS SCHWARTZ, of the U. S. Public Health Service, reported that nearly three-fourths of all occupational diseases are the skin troubles suffered by workers from handling materials used in industry. About one out of every 100 workers in industry suffers from such trouble. The metal industries produce nearly a third of the entire number of skin cases, and domestic and personal services and the food industries have more cases than building and construction industries. Plants, metals, alkalis, solvents, petroleum products and dyes are the chief offenders. Germs play a part by entering wounds and causing infections. Heat, cold, radium, x-rays and sunlight also are causes of some of the industrial skin diseases. Drs. Earl D. Osborne and James W. Jordan, of Buffalo, stated that about half the claims for workmen's compensation in the United States are due to skin diseases, and about half of these could be prevented. The way to prevention, they said, is to educate the worker to keep his hands as clean as possible and to wear special aprons, gloves and shields, and to provide these and facilities for cleanliness. In addition, they recommended care in the selection of workers, since persons whose skin is already irritated or who have had any type of eczema or ringworm are more likely to develop sensitiveness to materials handled in their work. Some of these cases of skin disease are due to special sensitiveness of the individual worker and some to irritants themselves such as strong acids, alkalis, metallic salts, soaps and cleaners, fat solvents, cement, plaster and many others.

DEAFNESS, nervous and emotional disorders, excessive fatigue, "the evil results of the loss of sleep," transient changes in blood pressure and the pressure within the brain with consequent increased pulse rate and irregularities in the heart rhythm, and digestive disturbances may all be caused by noise, it appears from the report of Dr. Carey P. McCord, of Detroit. These ill effects of noise were discovered as a by-product of the work of a special committee of the American Medical Association studying air conditioning. The closed windows and doors required by air conditioning, it was soon found, helped lessen the evil effects of noise, chiefly street noises. Deafness due to the noise they are exposed to at work is well known among boiler makers, blacksmiths, machinists, weavers, forgemen, aviators and railroad workers. Deafness in only one ear, that used for the telephone, is often found in train dispatchers. The first damage to the ear from noise, Dr. McCord said, probably has its beginning in fatigue. Pointing out the effect noise has in reducing productiveness in industry, Dr. McCord said that while irregular and unexpected noises are more distracting in routine work than repetitive noises of the same loudness, sustained noises reduce production about 7 to 8 per cent. About 90 per cent. of industrial noise can be reduced by 50 per cent. This means that manufacturers of machinery will have to produce noiseless or less noisy machines. The automobile is an example of what can be done in this line. The user of the machine can do much to reduce noise by proper maintenance. Sound deadening materials, as used in radio broadcasting studios, can be used to eliminate much noise. Finally Dr. McCord suggested "ear defenders" of wax, cotton or soft rubber, and soft soled shoes when vibration is a factor, as personal aids to noise reduction.

SINUS disease starts in infancy and the first five years of your life were the most important ones for determining whether or not you would be troubled with this ailment, it appears from the report of Dr. W. Walter Wasson, of Denver. He advises warm air for sinus sufferers. On this point, he said: "Fresh air with oxygen is desirable and many times necessary, but I doubt if this air should be cold. Patients with chronic sinus disease do better if their sleeping rooms are well ventilated, but ventilated with warm air of the proper humidity." This advice on treatment is based on the observation that most young children with sinus disease show a seasonal cycle, their sinuses showing a definite lack of air supply beginning about October and continuing till warm weather returns. Such children would be better off in a warm climate in the winter and attention should be paid to the air in their sleeping rooms. Discovery that sinus disease starts in infancy was made with x-rays. At birth the sinuses are filled with material which must be removed. This process takes from two to five weeks and the degree of clearing conditions the future development of sinus disease. Children whose sinuses clear promptly have fewer attacks of sinus trouble later in life. If the nose clears on only one side or not at all, sinus trouble usually occurs later. If the disease develops in infancy it may subside by the fifth birthday, but, if it does not, it becomes more definitely established, with changes in the tissues and bones.

—JANE STAFFORD

ITEMS

THE giant Douglas DC–4 air transport scored "perfect" on its initial two-hour flight test in the hands of Major Carl Cover, test pilot and vice-president of the Douglas Aircraft Company, makers of the plane. The big

plane, developed as a type for America's five major air lines, carried a gross load of 53,000 pounds at takeoff. It required less than half of the 2,800-foot runway of Cloverfield to get into the air. Two months of further flight testing will now follow. Seats and special instruments for eight flight observers have been installed in the plane.

NEW streamlined editions of two of America's most famous trains, New York Central's Twentieth Century Limited and Pennsylvania's Broadway Limited, were recently placed in service between New York and Chicago, cutting the running time by half an hour to 16 hours. The 16 hours now required for the extra fare train trip is the fastest ever run between New York and Chicago by rail.

MAYON, Philippine volcano which recently erupted, has a long reputation as a trouble-maker. It was first heard from in white man's history in 1616, and since then has been "in the papers" at frequent intervals. During the nineteenth century alone it blew off not less than twenty-seven times. Four of these eruptions took toll of human life. The first, just at the turn of the century, killed an unspecified number—"several persons" is all the record states. Then in 1814 came a major disaster, blotting out 1,200 lives. An eruption in 1853 killed 33 persons, and a larger one in 1897 killed 350. During the present century there was another major volcanic disaster in the Philippines, when another crater, Taal, exploded and destroyed many native villages, with a death list of 1,335.

EXPERIMENTS conducted by the U. S. Department of Agriculture indicate that apple trees of the future, breaking precedent with apple trees of to-day, may grow on their own roots. Government experimenters have succeeded in inducing stem cuttings of desirable varieties of apples to send out roots, according to Dr. F. E. Gardner, in charge of nursery stock investigation for the Bureau of Plant Industry. In the past, grafting was necessary because seedlings do not produce true to variety and because cuttings of stem tissues would not take root. Springtime taping of the growing root with black tape right up to the growing tip or enclosing the shoot in a black tube so changes the shoot that it will take root when removed from the tree in the fall. It is only necessary to make the basal cut, Dr. Gardner declares, before planting.

SYNTHETIC abrasives, made in electric furnaces, where hardness and the shape and size of the grains are under rigid control, are replacing natural abrasives rapidly, economists find. Last year, more than 8,000,000 tons of synthetic abrasives, mostly silicon carbide and aluminum oxide, were used by American industry, while less than half of that tonnage of natural abrasives was used, according to U. S. Bureau of Mines figures. The "sand" in sandpaper is now usually carefully-graded crushed garnet. Diamonds, the hardest known crystals, are still used almost exclusively for cutting and polishing other diamonds, and for drilling through rock. No synthetic substitute for diamonds has yet been found.

SCIENCE NEWS

Science Service, Washington, D. C.

FAMINE AND EPIDEMICS IN CHINA

THE worst famine in China's many centuries of periodic mass hunger and one of the worst epidemics of disease in the annals of mankind seem now to be inescapable as a result of the flood of China's Sorrow, the mighty Yellow River.

The flood of the great Hwang Ho, whether man-made or brought on by natural causes or both, is not going to recede soon. It is going to get worse. Pouring into the great plain of the provinces of Honan and Shantung on the heels of the torrential rains of the past few days will be the "spring melt" from the mountains of Tibet, the source of the Yellow River. This peak may be expected about mid-July. Two factors, flood and war, make the situation more serious than ever before. Cutting wide swaths through fertile farmlands as much as thirty feet below the bed of the river, the Hwang Ho is adding indescribable destruction to crops to the extreme dislocation caused by the war.

To the millions already made homeless by the war are being added the millions now homeless as a result of the flood. When the defeated, but not conquered, Chinese armies retreated westward, with them came uncounted millions of civilians fleeing the Japanese. Their care and, particularly, their feeding became a burden thrust upon Honan and Shantung, already burdened by having to support upwards of a million men under arms. To this already acute food problem is added the problem of feeding those who can look forward to nothing but a harvest of muddy water from their rice paddies and grain fields. And, it must be remembered, even in the best times, food is scanty enough in China.

It is on these facts that the expectation of a devastating famine is based. That famine will strike a population enormous portions of which are already weakened in their resistance to disease through China's semi-permanent state of mass malnutrition and as a result of the protracted war. The epidemic of disease, which may be cholera or typhus or both with dietary diseases as a trimming, is predicted upon the basis of the regularity with which disease follows flood and famine, particularly in a land where sanitary conditions are poor.

Reports from China during the past few months have persistently reported that Chinese refugees and soldiers alike are badly infected with typhus-carrying lice. An epidemic of typhus of major proportions is already regarded as long over-due. That such an epidemic will not take hold and spread with terrible rapidity in the severe conditions attending the flood—hunger and overcrowding among refugees of both the war and the waters—appears to be something not even the world's most enthusiastic optimist could hope.

A complicating factor appears in the report that the course of the Yellow River, which has changed several times during past centuries, is again changing, heading this time toward the Yangtze Kiang, China's mightiest river and one of the greatest streams in the world. Should the two rivers actually unite and should Chinese breach the dykes at Hankow in the event their temporary capital city falls to the Japanese, the resulting flood of the enlarged Yangtze would be the most disastrous flood in the history of the world. A major flood of the Yangtze would still occur, even if the Yellow River adheres to its course, and only the Yangtze went on a man-made rampage. The half of China's granary left untouched by the Yellow River would be ruined by an overflowing Yangtze.—LEONARD H. ENGEL.

ICEBERGS IN THE NORTH ATLANTIC

GIANT icebergs are still pouring down from Arctic waters into the steamer lanes of the North Atlantic, according to reports of the Hydrographic Office of the U. S. Navy. Already the year 1938 has seen over 700 bergs reported by the International Ice Patrol Service. This is nearly 50 per cent. more than the average number per year, since 1900. This average is 421. Originally the number of bergs forecast for 1938 was 530 but this number was exceeded before the first of June. Since then they have kept coming down from the north and are "still very heavy."

The current influx of ice menace means that European-bound steamers to northern ports must still, for some weeks, take the more southerly path which takes them off the "tail" of the Grand Banks of Newfoundland, rather than the quicker great circle path which penetrates the center of the iceberg danger area.

Many bergs, this year, are reported within a few miles of the spot at latitude 41 degrees, 46 minutes north, and longitude 50 degrees, 14 minutes west, where the *Titanic* sank on the night of April 14, 1912. It was this disaster which spurred international cooperation that has since made the Ice Patrol possible. Four times each day the tiny ships of this patrol send, by wireless, the positions of icebergs sighted.

There have been only three years since 1900 in which more than 1,000 icebergs have been sighted. In 1909 and 1912 some 1,020 bergs were reported and in 1929 the figure reached the peak of about 1,350 bergs. Nearly 900 bergs were reported in 1935 and the totals for 1938 may approach this magnitude before the coming of summer causes their retreat late in June and early in July.

WEATHER BUREAU RESEARCH

DR. WILLIS RAY GREGG, chief of the U. S. Weather Bureau, reported to the meeting of the American Institute of Electrical Engineers, that the Jones-Bankhead Act for research in the Department of Agriculture has made possible a study of the origin of winter's icy polar blasts. These polar air masses, Dr. Gregg pointed out, move southward and turn into the cold waves that invade and spread over large sections of the country. Upper air soundings by airplane and radiometeorographs have been made at Fairbanks, Alaska, Fort Smith, Canada, and

along the nation's northern border, which help trace the origins and movements of these polar air masses.

Through funds now available studies are also being undertaken to improve greatly the summer forecasts of thunderstorms and precipitation through the farm areas of the nation. The results thus far "give a substantial basis for optimism that forecasting of summer rainfall, including thunderstorms, will be materially improved and that the period of the forecasts can be extended to something like five days, possibly longer."

Studies are also being made of the ozone content of the air in its relation to atmospheric circulation. Measurements indicate that ozone is greatest in amount a short distance to the rear of low pressure areas and least in the corresponding part of high pressure areas. Dr. Gregg pointed out "It would seem then to be a valid assumption that the variations in the amount of ozone are related not to the barometric pressure itself, but rather to the sources of different air masses, the ozone being most abundant in polar and least in tropical air. There is thus the possibility of utilizing the measurements of ozone and its variations in forecasting the development and movement of different types of weather that are associated with fronts, anticyclones, cyclones, etc."—ROBERT D. POTTER.

A PREHISTORIC BREWERY

WHAT is believed to be a prehistoric brewery has been discovered in the Big Bend region of Texas by Frank M. Setzler, anthropologist of the Smithsonian Institution. Mr. Setzler, who has just returned to Washington, reports that he was seeking dwelling sites of a mysterious ancient Indian people whom he first detected in Texas caves seven years ago, when he came upon this extraordinary cave.

Clues which he and his cowboy assistants unearthed at the cave that suggest the theory that this was once a prehistoric ceremonial brewery include: (1) A great accumulation of fire-cracked stones inside and outside the cave, indicating a lot of cookery. (2) Although the débris was nine feet thick, it contains few animal bones left by diners, but a great deal of the débris consists of ashes of sotol. This sotol is a desert lily abundant in the region, from which Indians are known to make a potent alcoholic drink. It might be argued, Mr. Setzler says, that the sotol was used merely as firewood, and yet, what was cooked in such quantity at the cave, if not this plant? (3) Numerous stone implements in the cave trash include few that suggest housekeeping. The inference is that many Indians worked at the place, but that it was no popular dwelling. (4) A boulder with a big hollow fully a foot deep ground into it was found at the cave, and near-by was a large roller pestle. Such a combination of stones might suggest a big mortar and pestle. However, this hollowed boulder may have been the chief brewing kettle, in which roasted sotol was crushed and covered with water.

The Indian process of brewing the desert lily is to heat it, increasing the sugar content. Then they press the juice and let it ferment. This brewing method was used by the Indians, when white explorers came to this country, and it may well have been known far back in Indian prehistory.

Aside from being fairly certain that these Indians of the Big Bend caves were prehistoric, since they had no trace of European goods, Mr. Setzler says that he can not yet determine their antiquity. His hard digging into their dusty old cave shelters reveals the Texas cave dwellers as Indians who did little, if any farming. They had not acquired the useful art of making pottery. Their skulls are so long, compared to width, that they have the distinction of being the world's longest-headed people.

MARINE TELEPHONES FOR COASTAL VESSELS

BECAUSE modern aviation has demanded a superior radio telephone, commercial coastal vessels and yachts off the Atlantic seaboard can now install equipment which will permit persons at sea to talk with any telephone subscriber in the United States.

In a symposium at the meeting of the Institute of Radio Engineers, investigators from the Bell Telephone Laboratories, New York City, described the details of the new radio telephone which is designed for the contingencies of maritime use, and was developed from airplane radio telephone. Simplification of tuning makes it possible for relatively amateur operators to use the system. Speech is by a conventional handset type of mouth piece and ear-phone. Two dial switches, marked with station identification, enable the phone to be tuned into any of nine shore station channels in the short wave band of radio frequencies.

New features, not previously available in a mobile type of transmitter, include a special voice-controlled switch instead of the "press-to-talk" switch. The transmitter is put on the air a few thousandths of a second after talking begins, a time short enough to avoid objectionable clipping of the initial speech sounds. The carrier wave is maintained for a short period after talking ceases to prevent the transmitter from going off the air between syllables or words. A switch, mounted on the telephone stand in place of the ordinary dial, permits the radio telephone to be transferred to ship-to-ship radio frequencies or to the special Coast Guard emergency band. Part of the system of receiving the ship's telephone calls consists of on-shore, remotely-controlled radio receivers that pick up the marine telephone traffic.

Those participating in the symposium included: C. N. Anderson, H. M. Pruden, S. B. Wright, S. Doba, A. C. Dickieson, R. S. Bair, H. B. Fischer, all of the Bell Telephone Laboratories; W. M. Swingle, the Chesapeake and Potomac Telephone Company, Norfolk, Va., and A. Bailey, American Telephone and Telegraph Company, New York.

THINKING AND THE FRONTAL LOBES OF THE BRAIN

DR. RICHARD M. BRICKNER, of New York City, in reporting to the Americal Medical Association at the San Francisco meeting, suggested that his patient who had the whole front part of his brain removed gives a clue to the kind of thinking done not only by apes and monkeys, but presumably by man's earliest human ancestors.

More important to human medicine is the fact that Dr. Brickner's researches give new information on the anatomy of thinking. While thinking goes on in the back as well as the front of the brain, for complicated thought, such as combining two thoughts into a third, the front part of the brain is required. The patient without forebrain was not able to accumulate memories and then store them in the back of the brain. If he had been without speech, Dr. Brickner believes, his situation "would not be very different from that of a human ancestor."

The "slight glimmer of the action of the simian mind" was obtained from the patient's restlessness, his use of jargon mingled in his conversation, his boastfulness, his somewhat too good appreciation of the funny aspects of things and his own comical sallies.

This research involved the study and comparison of two patients who had parts of their brains removed. One patient had both frontal lobes removed. It was this patient's thought processes that gave the clue to simian thinking. His judgment about simple things is satisfactory, but he "is lost in evaluating matters which require putting many factors together," Dr. Brickner reported.

The second patient, who had only one frontal lobe removed, had this same difficulty in what Dr. Brickner called synthesizing thoughts, but was conscious of this defect in his thinking processes. He explained it to Dr. Brickner in the following way: He knew the initials E. A. and Q. were those of his name and he could think of E, and A, as composing the unit E. A. But although he knew the initial Q, and knew it belonged after the E. A. he could not think it so as to make the unit E. A. Q. This defect confused the patient and made him lose confidence in himself. His consciousness of this thinking defect gave the clue to the function of the frontal lobe.

This patient was able, two months after his operation, to return to his old job and perform it satisfactorily, according to his employer. The other patient, who lost both frontal lobes, often talked about having to get back to work, but eight years after his operation he had done nothing about this. He had lost initiative.

The differences in the two patients show, Dr. Brickner believes, that the intellectual function of the frontal lobes is bilateral, somewhat as the function of the eyes and the kidneys are bilateral. If one kidney becomes diseased and is removed, the other is able to carry on for both, and similarly if one eye is removed, the other can carry on to a large extent, though the patient has to turn his head to see from the side of the missing eye. The same thing apparently happens when one frontal lobe is removed. The patient can go on thinking with very little difficulty and is apparently unchanged, as all doctors have observed in this type of case. But with both lobes removed there are profound changes in the patient's thinking. These changes are quantitative and not qualitative, Dr. Brickner believes. The newer units in the back part of the brain which do a certain amount of thinking are apparently connected with units in the front of the brain on each side. A certain number of these frontal units are necessary for higher intellectual processes.

ITEMS

DR. HARLOW SHAPLEY, director of Harvard College Observatory, at the recent meeting of the American Association of Variable Star Observers, held at the Ladd Observatory at Brown University, stated that the galaxy of stars containing the earth and the sun, often thought of as a flat disk in space, is not as thin as it may seem. It would take light at least 100,000 years to cross the galaxy at its thickest part even though light travels at approximately 186,000 miles a second. A survey of 2,300 Cepheid variable stars of the cluster type, having periods of less than a day, made possible the new estimate of the shape of the galaxy. Our galaxy actually is surrounded by a thinly-populated spherical aura or halo of stars. In this it resembles the Andromeda nebula, one of the nearest of the spiral nebulae. The isolated star most remote from the plane of the Milky Way, known as BE Virginis, is distant 130,000 light years.

IT was reported to the meetings of the American Physical Society by Dorothy W. Weeks, of Wilson College, and Professor George R. Harrison, of the Massachusetts Institute of Technology, that a new and superior tool for identifying chemical elements by the characteristic lines which they emit when excited by an electric arc, or other means, is an improved spectrum of the positions of the very complex lines in the spectrum of iron. The spacing of these lines through the colors of the visible, and invisible, spectrum differs from one element to another and gives a rapid means of identification, even in very minute samples. The number of identified lines in the iron spectrum—which already number in the thousands—has now been trebled. The basic method in locating the position of a line in the spectrum of an unknown element, is to photograph the unknown spectrum and then, immediately adjacent to it, the spectrum of iron. The complex iron spectrum, with each of its line positions known, serves as a reference standard to help locate the lines of the unknown spectrum. By trebling the number of lines positively identified in the iron spectrum, scientists now have smaller gaps in their reference positions and the errors of measuring between reference points are lessened.

A NEW copper alloy, consisting of nearly pure copper and having the strength and hardness of steel, is announced by the Westinghouse Electric and Manufacturing Company. Containing small amounts of silver and chromium, "Cupaloy," as it is called, has been laboratory-tested to determine its hardness. An engraved insignia on a sample of the metal made a deep impression in a block of steel against which it was pressed by a hydraulic press; the copper alloy was scarcely marked. P. H. Brace, consulting metallurgist of the Westinghouse research laboratories, five years ago initiated the experiments which have culminated in the practical application of the alloy as welding electrodes, slip rings for generator rotors, cylinder heads in internal combustion engines and for other uses. Special heat treatments which make the atoms in the alloy re-assort themselves are the key to the manufacture of the substance. The alloy has a high electrical conductivity.